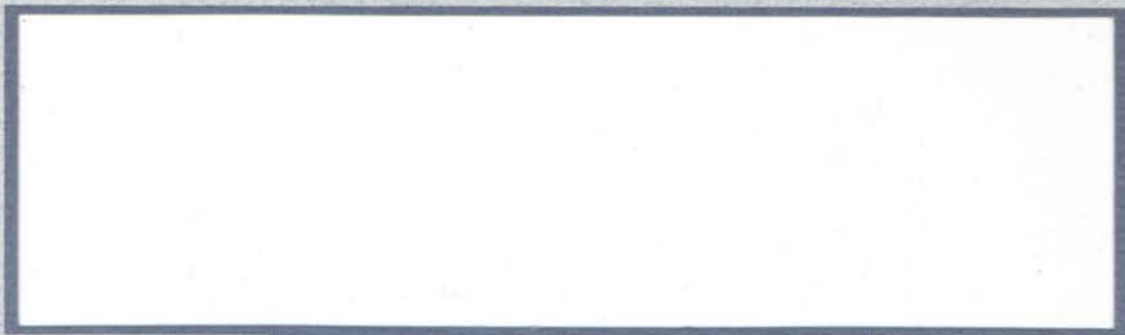


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**Quality Assurance Project Plan**  
**Phase II Remedial Design/Remedial Action**  
**Colbert Landfill**  
**Spokane, Washington**

*2/28/92*

February 28, 1992

Prepared for  
Spokane County, Washington

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## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) establishes the quality assurance (QA) objectives for Phase II of the Colbert Landfill Remedial Design/Remedial Action (RD/RA) project (Project); the QA organization and procedures developed to meet QA and Project objectives; the QA and quality control (QC) protocols and procedures associated with Phase II groundwater, treatment system influent/effluent, and soil sample collection and analysis; and data quality objectives (DQOs). The DQOs established for the Project reflect the intended use of Project data and, as such, prescribe the level of quality, accuracy, precision, completeness, comparability, and representativeness of data to be collected and analyzed. To assure quality data, this QAPjP establishes specific procedures for sample collection and handling; sample custody; equipment calibration procedures and frequency; laboratory analytical procedures; data reduction, validation, and reporting; internal QC; performance and system audits; preventative maintenance; and data assessment procedures, corrective actions, and QA reports.

Construction QA for each Phase II remedial action system component will be addressed in the respective work plans for each of the components (i.e., Phase II Groundwater Monitoring, Extraction Well, and Treatment and Discharge Plans). Long-term QA activities to verify extraction, treatment, and discharge system performance will be addressed in the Operations and Maintenance plans (to be submitted with the Phase II plans and specifications).

Guidance used for preparation of this QAPjP is contained in various U.S. Environmental Protection Agency (EPA) documents, including *The Quality Assurance Manual for Waste Management Branch Investigations, Region X* (EPA 1986a); *A Compendium of Superfund Field Operations Methods* (EPA/540/ P-87/001) (EPA 1987a); and other EPA (1979, 1981, 1982, 1983, and 1984a) and National Institute of Occupational Safety and Health (NIOSH 1988) guidance manuals and handbooks.

This QAPjP has been prepared by Landau Associates, Inc. (Landau Associates), engineering consultant to Spokane County (County) for design of the Colbert Landfill (Landfill) remedial action. Compliance with the provisions of this QAPjP will be the responsibility of the County, which may elect to contract a firm or individuals to assist in meeting the provisions of this QAPjP.

## **1.1 PROJECT DESCRIPTION**

### **1.1.1 Background**

The Landfill is an inactive 40-acre municipal solid waste landfill located approximately 15 miles north-northeast of Spokane, WA, and 2.5 miles north of Colbert, WA, as shown on the Regional Location Map (Figure 1-1). The Landfill operated until 1986, when it became filled to capacity with municipal and commercial waste.

Groundwater in the vicinity of the Landfill is contaminated with chlorinated organic solvents. This contamination has been traced to spent solvents that were disposed of at the Landfill. Solvents were reportedly disposed of at an average rate of several hundred gallons per month for a number of years, and primarily consisted of 1,1,1-trichloroethane (1,1,1-TCA) and methylene chloride (MC). Other organic solvents were also detected in groundwater near the Landfill, including trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1-dichloroethylene (1,1-DCE), and 1,1-dichloroethane (1,1-DCA). These six chlorinated organic solvents are referred to as the "Constituents of Concern."

In 1980, nearby residents complained to the Eastern Regional Office of the Washington State Department of Ecology (Ecology) about disposal practices at the Landfill. State and county officials, led by the County Utilities Department, initiated an investigation into complaints of groundwater contamination in the area by sampling nearby private wells. The results of this initial investigation indicated that some of these wells were contaminated with 1,1,1-TCA. In August 1983, EPA placed the Landfill on its National Priorities List (NPL).

Several studies of the Landfill were conducted since 1980, including the 1987 Remedial Investigation/Feasibility Study (RI/FS; Golder Associates 1987). The purpose of the RI/FS was to determine the nature and extent of contamination caused by the release of chemicals from the Landfill and to evaluate potential remedies. The RI determined that the two primary aquifers in the Landfill vicinity (the Upper and Lower Sand/Gravel Aquifers), and a low-productivity aquifer to the east of the Landfill (Weathered Latah/Basalt Aquifer), are contaminated with one or more of the Constituents of Concern previously described. The FS recommended a pump and treat remedy to address this groundwater contamination.

The EPA released its Colbert Landfill Record of Decision (ROD) for public comment in September 1987 (EPA 1987b). The remedial action site (Site) is defined in the ROD as the area of potential impact surrounding and including the Landfill, as shown on Figure 1-1. Based on recommendations in the FS, the ROD provides for a performance-based remedial action consisting of a groundwater pump and treat system. Project performance criteria for the



Constituents of Concern are presented in the ROD (Performance Standards), and are shown in Table 1-1. These performance standards establish the level of treatment for extracted groundwater and define the maximum constituent concentrations that must be achieved for completion of the remedial action.

Although some flexibility is allowed in the remedial approach, the conceptual remedial action specified in the ROD provides for a groundwater extraction system, a treatment system, and a discharge system. The ROD subdivides the extraction system into the following three pumping systems:

- The South Interception System, which will consist of a series of extraction wells installed to intercept the contaminant plume in the Upper Sand/Gravel Aquifer to the south of the Landfill
- The West Interception System, which will consist of a series of extraction wells installed to intercept the contaminant plume in the Lower Sand/Gravel Aquifer west of the Landfill
- The East Extraction System, which will consist of extraction wells installed in the Lower Sand/Gravel and Latah/Basalt Aquifers near the Landfill for source control.

Based on Phase I data and pilot tests, the conceptual remedial action specified in the ROD was refined. The three ROD-specified pumping systems will extract contaminated groundwater from near the plume's south, west, and east boundaries and pump the extracted water to a treatment system located just west of the Landfill. The treatment system will use air stripping to reduce Constituents of Concern in groundwater to ROD-specified performance standards. Treated water will be discharged, via the discharge system, to the Little Spokane River.

Subsequent to implementation of the ROD, a Consent Decree for the Landfill (U.S. District Court 1988) was negotiated between the EPA and Ecology (Government Plaintiffs), and the County and Key Tronic Corporation (Potentially Responsible Parties). By this action, the County agreed to implement the EPA-selected pump and treat remedy in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) requirements and the State of Washington Hazardous Waste Cleanup Act, codified as Chapter 70.105B RCW.

It was recognized during development of the Consent Decree that available data were inadequate to design the selected remedial action. Consequently, the RD/RA is being implemented in phases. Phase I activities included the installation and sampling of additional

characterization of groundwater contaminant distribution and site hydrogeology, and the development of engineering parameters needed for design of the final (Phase II) remedial action. Phase I activities were completed in July 1991, with Phase I results provided in the Phase I Engineering Report (Landau Associates 1991). This QAPjP is similar to the QAPjP developed for Phase I activities (Landau Associates 1989). Phase I corrective actions resulting from laboratory and field audits are provided in Appendix C of the Phase I Engineering Report (Landau Associates 1991) and are incorporated into this QAPjP.

### **1.1.2 Site Conditions**

The Landfill is located on a plateau that is bounded on the west by a steep slope descending toward the Little Spokane River and on the east by low granite and basalt hills. Surface drainage is to the west, towards the Little Spokane River. The climate is characteristic of eastern Washington, with temperatures ranging from typical average summer highs of 83°F to average winter lows of 23°F. The relatively low annual precipitation of approximately 17 inches falls mainly during the winter months of November through February (NOAA 1985).

The geology of the Landfill area consists of a series of glacially and fluvially-derived materials deposited on an eroded landscape of clays, basaltic lava flows, and granitic bedrock. Groundwater in the area is primarily obtained from the Upper and Lower Sand/Gravel Aquifers, which have been contaminated by the Constituents of Concern. The remedial action is focusing on the extraction and treatment of contaminated groundwater from these two aquifers. The approximate extent of contamination in the Upper and Lower aquifers, as characterized in Phase I RD/RA assessments, is shown on Figures 1-2 and 1-3 for the Upper Sand/Gravel Aquifer and Lower Sand/Gravel Aquifer, respectively.

## **1.2 PROJECT OBJECTIVES**

The primary objectives of Phase II RD/RA activities are to design, construct, and operate a final groundwater extraction, treatment, and discharge system that meets the performance requirements established in the Consent Decree.

Phase II design and construction will address site hydrogeologic and environmental conditions, based primarily on data collected and analyses performed during Phase I RD/RA activities. Design and construction will be performed utilizing generally accepted engineering practices in effect in the County at the time pertinent Phase II activities are conducted.

Groundwater and soil samples will be collected and analyzed during Phase II RD/RA construction activities. The scope of Phase II construction sampling and analysis activities is as follows:

- Groundwater (one sample per well) will be collected and analyzed for the Constituents of Concern and selected physical parameters to verify plume migration conditions and overall groundwater quality. These data will represent baseline data against which the effectiveness of Phase II interception, extraction, treatment, and discharge activities can be compared.
- Soil will be collected (about one sample per every 5 ft of monitoring well boring interval) for physical and visual inspection and logged to verify and supplement Site geologic conditions only; chemical analysis of soil samples will not be conducted under Phase II.
- Treatment system influent/effluent water samples will be collected during treatment system startup and will be analyzed for the Constituents of Concern, selected index parameters, and appropriate National Pollution Discharge Elimination System (NPDES) parameters, both prior to treatment (near intake to the treatment system) and posttreatment (prior to discharge to the Little Spokane River) to assess compliance with treatment and NPDES discharge requirements.

Groundwater and treatment system influent/effluent samples will be collected during long-term Phase II operation. The QA/QC procedures for Phase II operational sampling will be the same as those discussed in this QAPjP. However, operational QA/QC will be addressed separately in the Operations and Maintenance Plan, which will be submitted concurrently with the Phase II plans and specifications.

### 1.3 PROJECT DATA QUALITY OBJECTIVES

Laboratory data generated during this Project will provide the basis for accomplishing the Phase II Project objectives in Section 1.2.

The primary DQO for Phase II RD/RA activities is to obtain data of sufficient quality to provide a high degree of confidence in the data's precision, accuracy, representativeness, completeness, and comparability. The data will be used by EPA, Ecology, and the County to: 1) supplement Phase I groundwater quality and geologic data (including data on plume extent and migration characterization); 2) verify the effectiveness of the Phase II groundwater extraction, treatment, and discharge systems in reducing the Constituents of Concern to the Performance Standards presented in the Consent Decree; and 3) support the refinement of Phase II design (if needed) subsequent to construction and operation of the Phase II remedial action.

The Project objectives can be achieved using data of analytical level III; that is, data from analyte-specific, non-Contract Laboratory Program (CLP) procedures, as described by EPA (1987c). Level III is consistent with the Consent Decree SOW requirements as well. Rigorous attention will be paid to QA/QC to assure (to the degree practicable) that analytical data will be of high quality.

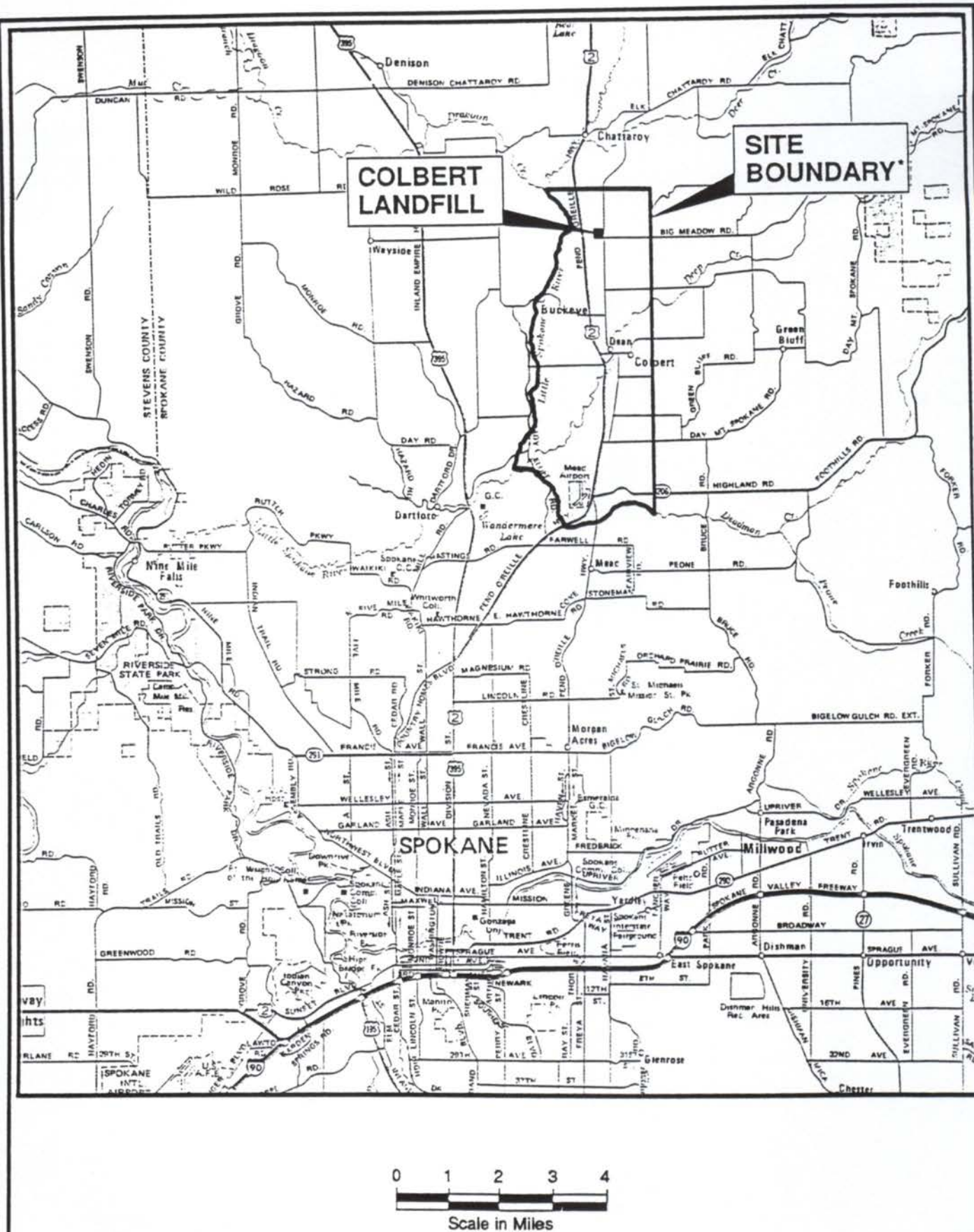
The QA procedures presented in this document are developed to assure that the DQO described above is met, as well as to assure that data generated are representative of actual conditions at the Site. The overall goal of the Project QA program is:

- To assure a reasonable degree of confidence in Phase II data collected in support of groundwater extraction, treatment, and discharge systems construction and operation; and in results of associated assessments through the establishment of a rigorous system of quality and performance checks on data collection, analysis, and reporting activities, as well as appropriate and timely corrective action to ensure compliance with established performance and quality criteria.

To accomplish this goal, the following QA Project objectives have been established:

- To establish, with the complete support of project management, a Project QA function that is sufficiently independent of Project technical activities to assure appropriate levels of review and surveillance of Project activities and data
- To establish and define the duties and responsibilities of personnel involved in QA activities
- To establish effective systems for Project documentation to assure proper development, use, and review of the data
- To establish QA procedures that provide for sufficient objective evidence to verify that laboratory, field sampling, and other technical activities are performed in accordance with established technical procedures and requirements.

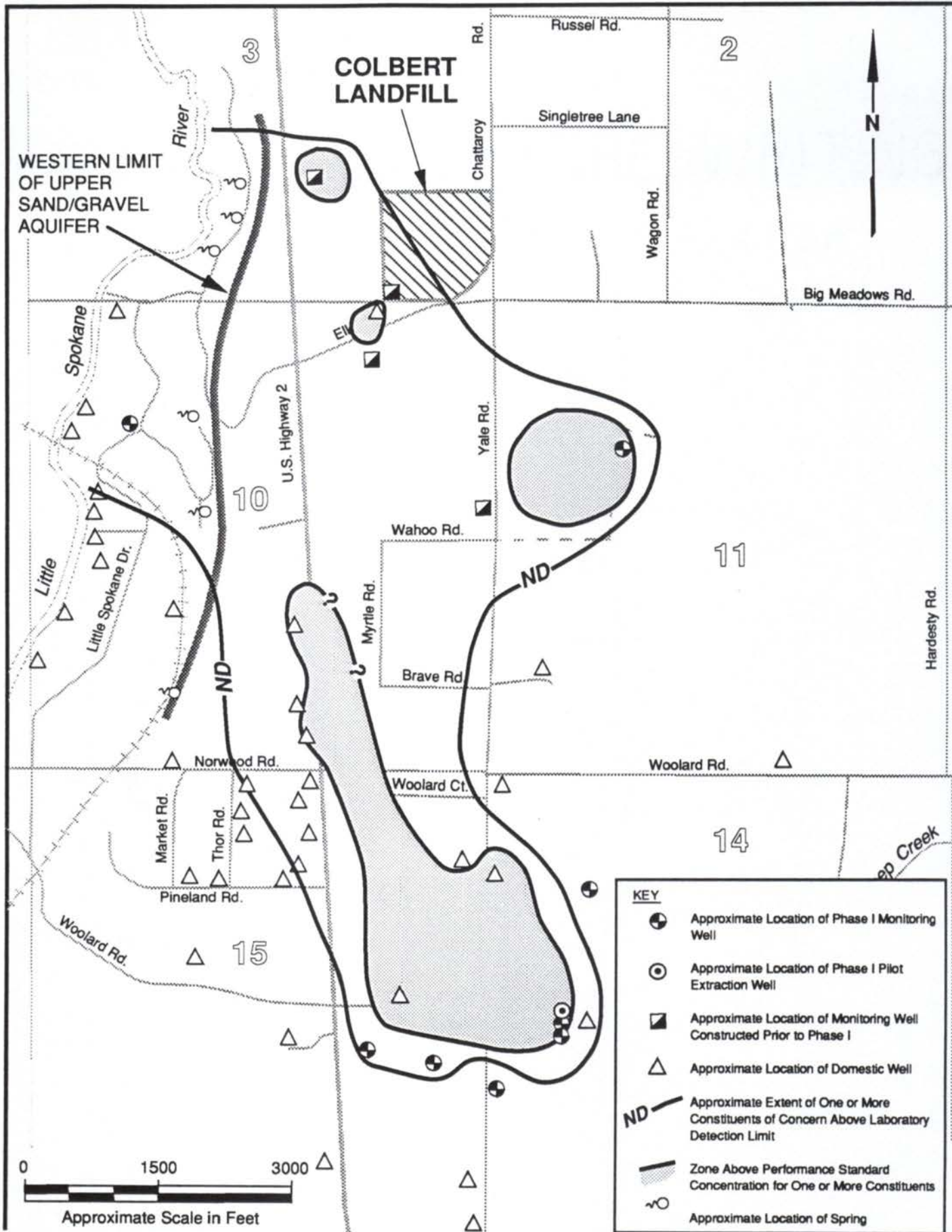
As previously discussed, this QAPjP presents the procedures and methods for sampling and sample handling, sample chain-of-custody, instrument/equipment calibration, chemical analysis, internal quality control, auditing, and data assessment developed to meet Project and QA objectives.



Regional Location Map

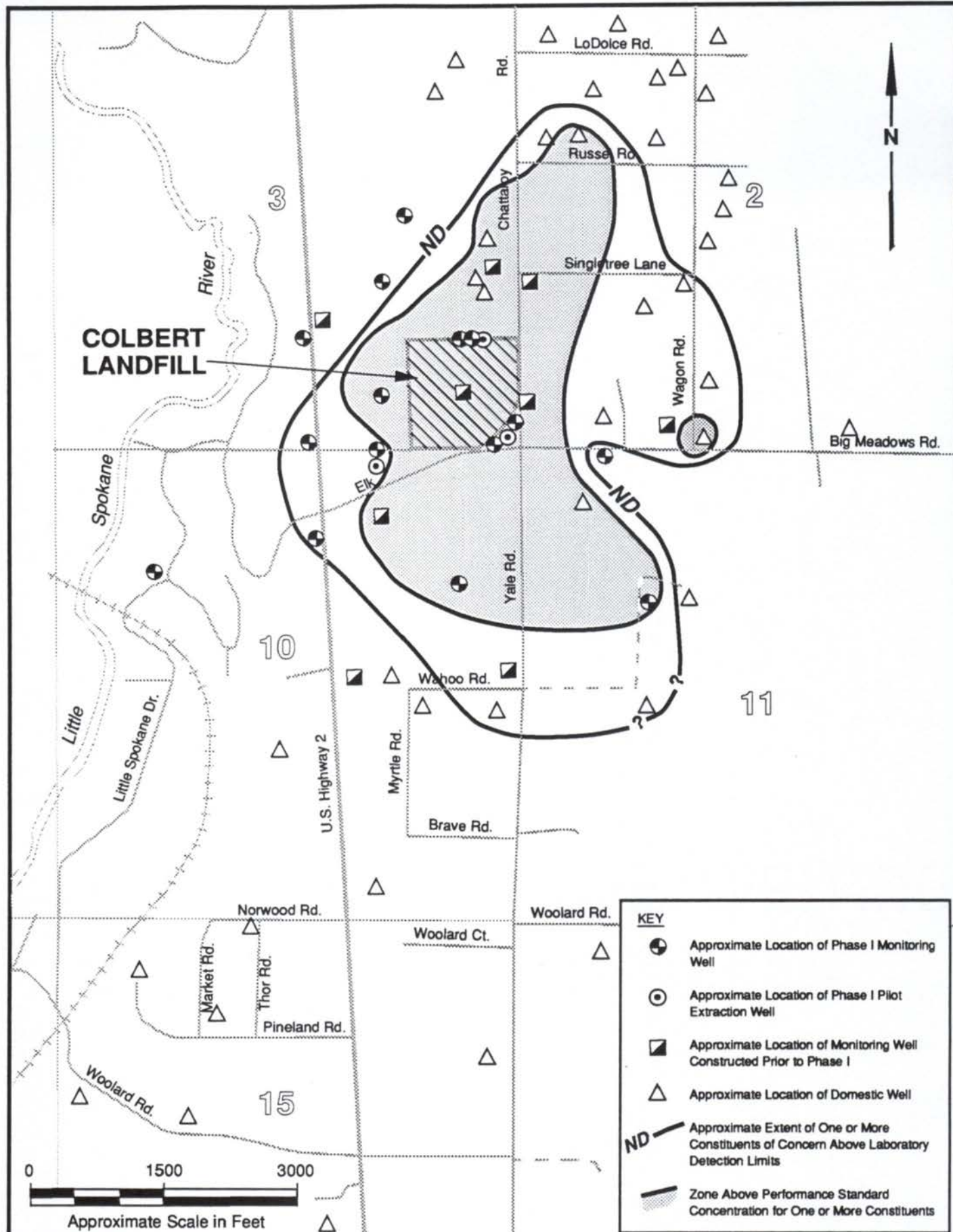
Figure 1-1





Upper Aquifers  
Approximate Extent of Constituents of Concern

Figure 1-2



Lower Aquifers  
Approximate Extent of Constituents of Concern

Figure 1-3

TABLE 1-1  
PROJECT PERFORMANCE STANDARDS

Constituent of Concern	Performance Standard <sup>(a)</sup>
1,1,1-Trichloroethane	200
Trichloroethylene	5
1,1-Dichloroethane	4,050
1,1-Dichloroethylene	7
Methylene chloride	1.0
Tetrachloroethylene	0.7

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(a) Concentration in parts per billion.



## 2.0 PROJECT QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITIES

Spokane County, through its Project Manager (Spokane County Project Manager), is ultimately responsible for assuring compliance with the provisions of this QAPjP. The County may elect to contract with an appropriate firm or individuals to provide the QA organization and personnel required to assist the County in meeting the Project QA responsibilities prescribed in this QAPjP. While specific individuals with Project QA responsibilities have not yet been identified, the QA organization will include, in addition to the Spokane County Project Manager, a Field Services Project Manager responsible for field and QA activities. If the County elects to conduct all Phase II QA activities internally, the Spokane County Project Manager and Field Services Project Manager positions could be combined. In addition, a separate QA Coordinator (QAC) and Laboratory QA Officer would need to be identified or contracted by the County.

The Project QA organization, showing individuals with QA responsibility and lines of QA authority, is shown on Figure 2-1. Specific Project QA responsibilities for the Field Services Project Manager, QAC, and Laboratory QA Officer are listed by responsible individuals in Table 2-1.

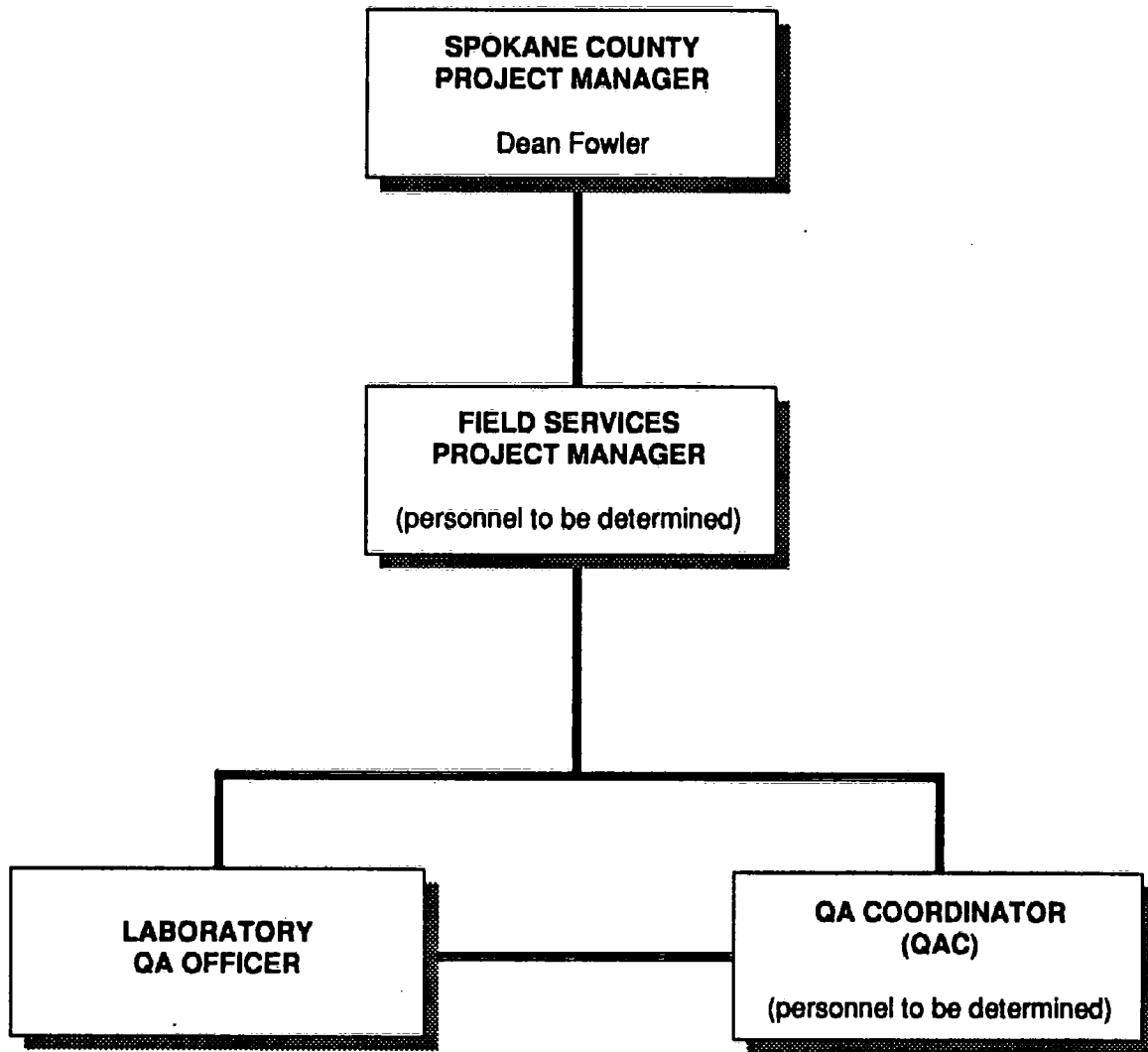


TABLE 2-1  
QUALITY ASSURANCE RESPONSIBILITIES

Personnel	Responsibilities
Field Services Project Manager	Coordinate technical Project direction and product technical review; coordinate project/agency interaction; review project QA needs and approve appropriate QA corrective actions as needed; oversee technical project team performance to ensure successful accomplishment of technical and QA project objectives
Project QA Coordinator (QAC)	Provide technical QA assistance; direct implementation of QAPJP; arrange contract or other external procurement packages for QA needs; prepare corrective action response; prepare and submit QA reports to project management; and conduct or supervise laboratory and field audits.
Laboratory QA Officer	Ensure that all laboratory QA objectives are met and laboratory QA/QC information is properly documented and reported.

### 3.0 DATA QUALITY OBJECTIVES FOR PARCC PARAMETERS

The purpose of this section is to describe DQOs for precision, accuracy, representativeness, completeness, and comparability (PARCC) of Project data. Specific procedures to be used for sampling, chain of custody, calibration, laboratory analysis, reporting, internal QC, audits, preventative maintenance, and corrective action are described in other sections of this QAPjP. Detection limits are discussed in Section 7.0.

Samples will be analyzed in accordance with accepted analytical procedures. These procedures were selected from published methods contained in the following documents: *SW-846 Test Methods for Evaluating Solid Waste*, Third Edition (EPA 1986b) and *Standard Methods for the Examination of Water and Wastewater*, Sixteenth Edition (APHA-AWWA-WPCF 1985).

Groundwater and influent/effluent samples will be analyzed for selected chemical and physical parameters to assess Phase II interception and system treatment effectiveness and compliance with Project discharge and cleanup requirements. Soil samples will be analyzed for physical properties only to supplement data on hydrogeologic conditions at the Site.

#### 3.1 PRECISION AND ACCURACY

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. It is expressed as a standard deviation or relative percent difference. Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property),  $X$ , with an accepted reference or true value,  $T$ . Accuracy can be expressed as the difference between the two values ( $X-T$ ), the difference as a percentage of the reference or true value ( $100(X-T)/T$ ), or as a ratio ( $X/T$ ). Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of spiked samples.

Accuracy and precision are determined through QC parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, laboratory duplicates, QC check samples, and blind field duplicates. The Project DQOs for the evaluation of these parameters are based on those given in the method or on functional guidelines outlined by the EPA for evaluating inorganic and organic analyses (EPA 1988a,b, 1991). Project QC objectives for surrogate recovery control limits (expressed as a percent of recovery), and for matrix spikes and matrix spike duplicate control limits [expressed as a percent of recovery and relative percent difference (RPD)] are listed in Tables 3-1 and 3-2, respectively. Control limits listed in these tables are consistent with EPA guidelines contained in the specific methods. These control limits will be used as criteria for

data acceptance. If the required QC limit for replication or recovery is not met, corrective action will be performed by the laboratory following the guidelines presented in Section 13. If the corrective action is performed and QC objectives still are not met, the QAC will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate. Such action may include reanalysis of the sample or other determination to be made by the QAC and the Field Services Project Manager.

In addition to matrix spikes and matrix spike duplicates, QC samples for verification of precision and accuracy include laboratory duplicates, QC check samples, and blind field duplicates (Section 9.1). Acceptance criteria for volatile organic compounds QC check samples are given in Method 8010. If sample concentration is greater than five times the Project Contract Required Detection Limit (CRDL), QC objectives for laboratory duplicates and blind field duplicates will be a Relative Percent Difference (RPD) of  $\pm 20$  percent for inorganic or organic analysis of water. If the sample duplicate concentration for a given compound is less than five times the CRDL, then the acceptance criteria will be the sampling concentration  $\pm$ CRDL.

If results for the QC check samples, laboratory duplicates, or blind field duplicates are outside the control limits, corrective action and/or data qualification requirements will be determined on a case-by-case basis by the QAC. The matrix of the QC check samples may not match the field sample matrix and blind field duplication can be poor due to sample inhomogeneity. Therefore, corrective action will be determined by the QAC and discussed in the data QA report.

### 3.2 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Sample locations and field sampling procedures have been chosen to maximize representativeness. The degree of representativeness will be measured by repetitive measurements of the same parameter at the same sampling location over several distinct sampling events. The potential effect of seasonal variations and sampling on accuracy will also be considered with respect to representativeness.

### 3.3 COMPLETENESS

Completeness is a measure of the proportion of data specified in the sampling plan that is determined to be valid. The QA objective for completeness during this project will be 90 percent.

### 3.4 COMPARABILITY

Comparability is an expression of the confidence with which one data set can be compared to another. All measurements will be made so that results are consistent and representative of the media and conditions measured. All data will be calculated, qualified, and reported in units consistent with EPA guidelines. Method detection limits and units to be reported are described in Section 7.0 of this document.

TABLE 3-1

SURROGATE RECOVERY CONTROL LIMITS  
IN WATER SAMPLES

Surrogate Name	Control Limits (percent)
Volatile Organics by Gas Chromatography (GC)	
Bromofluorobenzene	86-115

TABLE 3-2  
LABORATORY MATRIX SPIKE/MATRIX SPIKE DUPLICATE CONTROL LIMITS  
IN WATER SAMPLES

	Recovery (percent)	RPD <sup>(a)</sup> (percent)
<u>Volatile Oorganics Analyses by GC</u>		
1,1-Dichloroethylene	61-145	20
Trichloroethylene	71-120	20
<u>Metals</u>		
Iron	75-125	20
Manganese	75-125	20
<u>Anions</u>		
Chloride	75-125	20
Sulfate	75-125	20
Nitrate/Nitrite	75-125	20
Phosphate	75-125	20
<u>Other</u>		
Total Dissolved Solids	NA <sup>(b)</sup>	20 <sup>(c)</sup>
Biological Oxygen Demand (5 day)	NA <sup>(b)</sup>	20 <sup>(c)</sup>
Chemical Oxygen Demand	NA <sup>(b)</sup>	20 <sup>(c)</sup>
Hardness	NA <sup>(b)</sup>	20
Total Organic Carbon	69-135	20
Total Organic Halides	66-124	20

(a) RPD = Relative percent difference.

(b) Replicate samples are substituted for matrix spike/matrix spike duplicate.

(c) If concentration is <100 mg/L, then RPD is  $\pm 10$  mg/L.



## **4.0 SAMPLING PROCEDURES AND HANDLING**

### **4.1 SAMPLING SITE SELECTION AND OBJECTIVES**

As previously discussed, groundwater, soil, and influent/effluent samples will be collected during Phase II RD/RA activities. Groundwater samples will be collected from existing and new Phase II monitoring and extraction wells located proximate to contaminant plumes. Phase II monitoring and extraction well locations are shown on Figure 4-1. Influent/effluent samples will be collected from the intake/discharge (respectively) of the treatment system.

Groundwater samples collected from Phase II monitoring and extraction wells will be analyzed for volatile organics (the six Constituents of Concern) to evaluate interception system performance and operational settings. Treatment system influent and effluent will be analyzed for volatile organics (the six Constituents of Concern) to evaluate treatment system performance, and will be analyzed for total dissolved solids, hardness, and (possibly) alkalinity to evaluate the effectiveness of scale control measures. Treatment system effluent samples will also be analyzed for National Pollutant Discharge Elimination System (NPDES) parameters, including one or more of the following:

- Biological oxygen demand
- Chemical oxygen demand
- Total organic carbon
- Total suspended solids
- Phosphorous (as P).

Groundwater and treatment system influent/effluent samples will also be analyzed (in the field) for pH, specific conductivity, and temperature.

Soil samples will be collected in boreholes drilled during new monitoring and extraction wells construction. Soil samples will be collected for analysis of physical properties only; no chemical analysis of soil samples will be conducted in Phase II.

### **4.2 SAMPLING PROCEDURES**

Sampling procedures for each matrix group are presented in the Field Sampling Plan (Appendix A). Table 4-1 presents information on the matrix to be sampled and analyzed, chemical analyses to be conducted, sample containers and sample preservation methods to be used, and maximum sample holding times.

#### **4.3 CHAIN-OF-CUSTODY PROCEDURES**

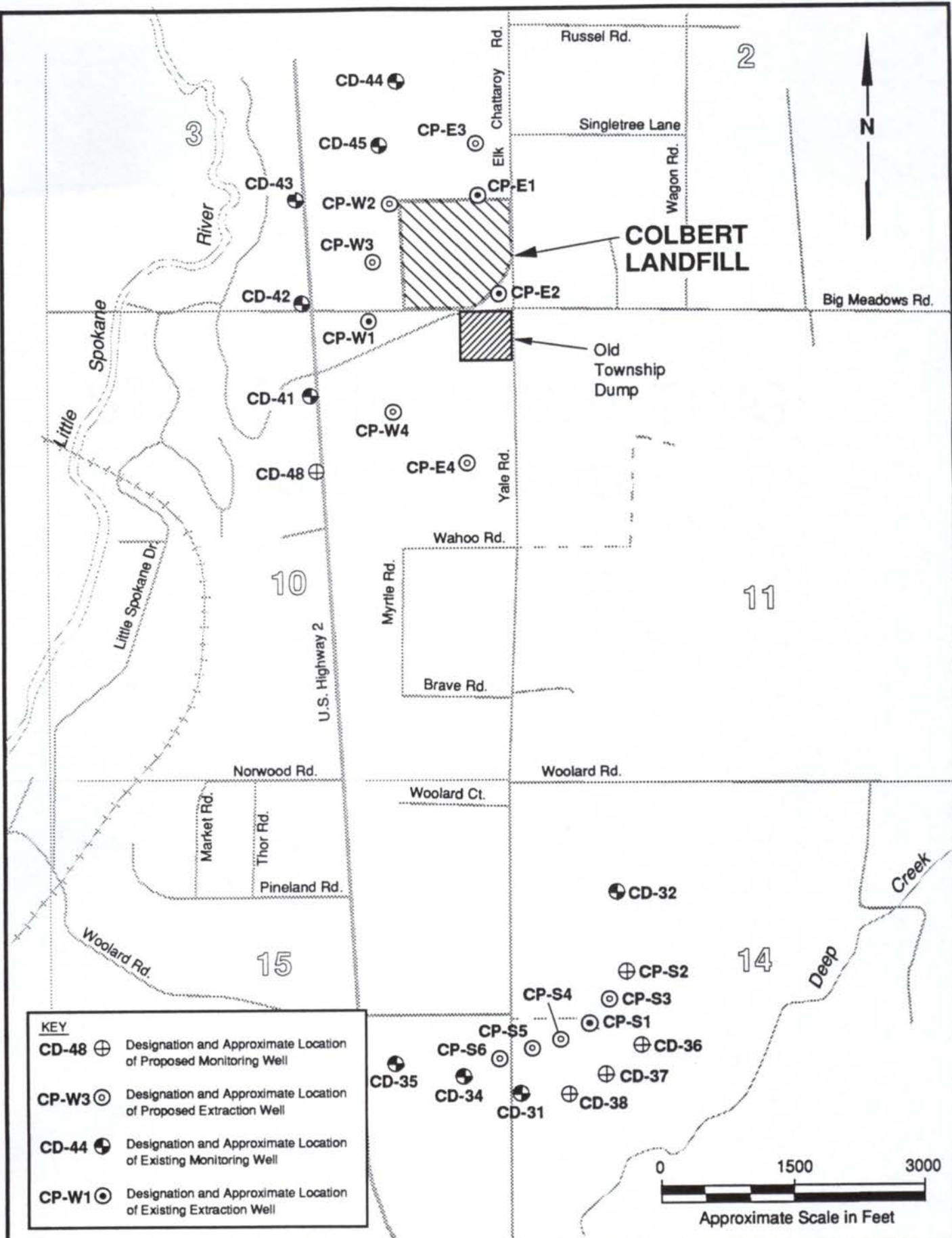
Sample control and chain-of-custody procedures are addressed in Section 5.0.

#### **4.4 SAMPLE DOCUMENTATION**

Sample documentation will comply with procedures contained in Section 4.6 of *A Compendium of Superfund Field Operations Methods* (EPA 1987a). Project sampling and sample handling will be documented through the use of the records summarized in Table 4-2. Examples of forms to be used for sampling activities are presented in the Field Sampling Plan (Appendix A).

#### **4.5 LABORATORY COORDINATION AND REPORTING**

The analytical laboratory will perform chemical analysis of groundwater samples. The Project Field Representative will coordinate sampling activity with the laboratory to assure that all samples can be processed within the required holding times. (Actual holding times will be verified by review during data validation as described in Section 8.0).



Location of Phase II Monitoring and Extraction Wells

Figure 4-1

TABLE 4-1

## SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Matrix	Analyses	Sample Container <sup>(a)</sup>	Preservation	Holding <sup>(b)</sup> Time
Groundwater	Volatile Organics	2 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Maintain on ice	14 days
Influent/Effluent	Volatile Organics	2 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Maintain on ice	14 days
	Total Dissolved Solids	16-oz plastic	None	7 days
	Hardness	4-oz plastic	H <sub>2</sub> SO <sub>4</sub> to pH <2	6 months
	Alkalinity	4-oz plastic	None	14 days
NPDES	Biological Oxygen Demand	16-oz plastic (no headspace)	None	48 hours
	Chemical Oxygen Demand	16-oz glass	Maintain on ice H <sub>2</sub> SO <sub>4</sub> to pH <2	28 days
	Total Suspended Solids	16-oz plastic	None	7 days
	Total Organic Carbon	100 mL glass, Teflon-lined septum cap (leave no headspace)	Maintain on ice H <sub>2</sub> SO <sub>4</sub> to pH <2	28 days
	Phosphorous (as P)	4 oz/8 oz plastic	None	48 hours

(a) Sample container specifications may be modified after consultation with the analytical laboratory.

(b) Holding times are from date of collection. All samples will be shipped to the laboratory within 24 hours (except as noted for samples collected on Friday).

**TABLE 4-2**  
**SAMPLING AND SAMPLE HANDLING RECORDS**

<b>Record</b>	<b>Use</b>	<b>Responsibility/Requirements</b>
Field Log Book	Record significant events, observations, and measurements.	Maintained by sample collector; must be bound; all entries factual, detailed, and objective; entries must be signed and dated.
Sample Collection Form	Provide a record of each sample collected (Appendix B)	Completed, dated, and initialed by sample collector; maintained in project file.
Log of Exploration Form	Record geologic and groundwater table data during field explorations; used to develop final logs of borings and well logs (Appendix B).	Completed by Project field representative; maintained in project file.
Sample Label	Accompanies sample; contains specific sample identification information.	Attached to sample container by analytical laboratory and completed by sampler.
Chain-of-Custody Record	Seals sample shipment container to prevent tampering or sample transference (Appendix B).	Completed, signed, and applied by sample collector at time samples are transported.
Sample Analysis Request Packing List	Provides a record of each sample number, date of collection/transport, sample matrix, analytical parameters for which samples are to be analyzed, and condition of samples on receipt at laboratory (Appendix B).	Completed by sample collector at time of sampling transport; carbonless copies distributed to laboratory (copy 2) and project file (copy 1).

## 5.0 SAMPLE CUSTODY

Strict chain-of-custody procedures will be followed on the Project to maximize sample integrity and accountability. Sample control and chain of custody in the field and during transport to the laboratory will be conducted in accordance with procedures described in Section 4.0 of *A Compendium of Superfund Field Operations Methods* (EPA 1987a) and Section 4.1.10 of Appendix A to this QAPjP. Sample control and custody at the laboratory through sample disposal will be conducted in accordance with procedures contained in the CLP SOWs for organics (EPA 1990) and inorganics (EPA 1987d) analysis.

A chain-of-custody form similar to that presented in Appendix A will be used for the Project. When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Form and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Project documentation of sample custody will be verified by the QAC during regular review of the data validation package. Data validation is discussed further in Section 8.0.

## **6.0 CALIBRATION PROCEDURES AND FREQUENCY**

### **6.1 LABORATORY INSTRUMENTS**

Laboratory instruments will be calibrated and their performance evaluated in accordance within the methods procedures, cited in Appendix B. Instrument performance will be evaluated against appropriate check standards and calibration blanks for each parameter prior to commencing actual analysis on each day the analysis is performed. Divergence from benchmark criteria (as defined in the above-cited methods) will be corrected prior to analysis.

For volatile organics analysis in water, the GC will be calibrated initially for each analyte with a 5-point calibration using concentrations established according to guidelines in the method. Linearity must be established by a variation of less than 20 percent RSD in the calibration factor throughout the working range. The calibration will be verified each day using one or more calibration standards, and must vary less than 15 percent from the initial calibration. Continuing calibration will be performed throughout the day using a mid-level standard and will vary less than 15 percent from the initial calibration factors. Retention time windows will be established for each analyte according to Method 8010. These retention time windows will be updated daily according to the method and all continuing standards must fall within the windows.

After calibration and standardization of instrumentation are within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check sample will be analyzed and evaluated according to criteria in the method. Instrument performance check standards and calibration blank results will be recorded in a laboratory log book, which will also contain evaluation parameters, benchmark criteria, and maintenance information (see Section 11.0). Table 6-1 presents suggested QC check materials for laboratory analysis and for field equipment measurement parameters not addressed in the methods cited above.

### **6.2 FIELD INSTRUMENTS**

Six field instruments (photoionization detector, combustible gas indicator, pH meter, conductivity meter, thermometer, and water level indicator) will be used during construction and initial Phase II sampling for the Project. The field meters will be calibrated (if applicable) in accordance with manufacturer's instructions, which are presented in Appendix B. QC limits for

accuracy and precision of the field analyses are listed in Table 6-2. The water level indicator probe will be compared periodically to a steel measuring tape.

Calibration results will be recorded in an instrument log book dedicated to each field instrument. This log book also will contain instrument preventive maintenance information, as appropriate.

Additional field instruments may be utilized during long-term Phase II operation. Calibration procedures and frequency for field instruments not addressed in this QAPP, that are used during long-term Phase II operation, will be addressed in the Phase II Operation and Maintenance Plan (to be submitted concurrently with the Phase II plans and specifications).



TABLE 6-1  
INSTRUMENT PERFORMANCE CHECK  
MATERIALS AND FREQUENCY

Parameter	Check Material <sup>(a)</sup>	Frequency
<u>Laboratory Analysis</u>		
Biological Oxygen Demand	NA	NA
Chemical Oxygen Demand	NA	NA
Total Dissolved Solids	NA	NA
Total Suspended Solids	NA	NA
Total Organic Carbon	5 mg/L standard solution	Daily or every 15 samples <sup>(b)</sup>
Hardness	Commercially prepared standard solution	Daily or every 20 samples <sup>(b)</sup>
Alkalinity	NA	NA
Phosphorous	Standardized cuvettes	Once/Year
<u>Field Measurement</u>		
pH (meter)	pH 4, 7, 10 standard buffer solution	Minimum of every 4 hours of field use
Conductivity	0.01N KCl standard solution	Minimum of every 4 hours of field use
Temperature	National Bureau of Standards thermometer	Minimum of every 6 months

(a) Check materials are subject to change based on actual preliminary instrument qualifying results.

(b) Whichever is greater; daily is defined as every day the analysis is performed.

NA = Not Applicable.

TABLE 6-2  
FIELD ANALYSIS QUALITY CONTROL LIMITS

Parameter	Units	Accuracy	Precision
pH unit	Standard pH units	±0.1 pH unit	±0.1 pH unit
Specific conductivity	umhos/cm	±5%	±5%
Temperature	°C	±0.1°C	±0.1°C
Water level indicator	inches	±0.01 inch	±0.01 inch
Photoionization detector	parts per million	±5%	±5%
Combustible gas indicator	Percent lower explosion limit	±7%	±7%

## 7.0 ANALYTICAL PROCEDURES

The EPA methods have established detection limits (and, in some cases, quantification limits) covering each analyzed constituent for use nationwide as a contractual requirement for analytical laboratories. Quantification limits were established after considering typical ranges of interferences affecting quantification of constituents in representative environmental samples. Quantification of constituents at levels below the established quantification limits may be achieved if interferences are not significant. For highly contaminated samples, matrix effects may require higher quantification limits.

General methods and method quantification limits for analyses to be performed are summarized in Table 7-1. Methods for analysis will include analytical procedures commonly employed by the project laboratory and verified as to accuracy and precision. QC checks and decision criteria for determining if an analysis is within QC requirements will follow the guidelines given in the method.

Where appropriate and consistent with anticipated data uses (and in recognition of the validation requirements), these procedures may be modified, with the concurrence of the QAC, to incorporate techniques familiar to the Project laboratory. Deviations from EPA methods must be substantiated by full data verification and validation procedures according to requirements presented in the *EPA 530/SW-87/008 Test Method Equivalency Petitions Manual* (EPA 1987e). Any such procedure deviations deemed significant by the QAC will be submitted to the EPA and Ecology for review and concurrence prior to implementation.

TABLE 7-1  
METHODS AND QUANTIFICATION LIMITS FOR  
ANALYSIS OF GROUNDWATER

Analyte	Technique	Analysis Method	Quantification Limit
<u>Volatile Organics</u>	GC/HSD	SW 8010 <sup>(a)</sup>	
<u>Constituents of Concern</u>			
1,1,1-Trichloroethane (1,1,1-TCA)			0.3 µg/L
1,1-Dichloroethylene (1,1-DCE)			1.3 µg/L
1,1-Dichloroethane (1,1-DCA)			0.7 µg/L
Trichloroethylene (TCE)			1.2 µg/L
Tetrachloroethylene (PCE)			0.3 µg/L
Methylene chloride (MC)			1.0 µg/L <sup>(b)</sup>
<u>Inorganic Constituents</u>			
Biological Oxygen Demand	Modified Winkler or Probe Method	EP 405.1 <sup>(c)</sup>	1 mg/L
Chemical Oxygen Demand	Titrimetric	EP 410.4	10 mg/L
Total Dissolved Solids	Gravimetric	EP 160.1	10 mg/L
Total Suspended Solids	Gravimetric	EP 160.2	4 mg/L
Total Organic Carbon	Infrared	SW 9060	1.0 mg/L
Phosphorous	Colorimetric	EP 365.1	0.01 mg/L
Hardness	Titrimetric	EP 130.2	1 mg/L
Alkalinity	Titrimetric	EP 310.1	1 mg/L
<u>Field Parameters</u>			
pH	Electrometric	SW 9040	0.1 pH unit
Specific Conductivity	Specific Conductance	SW 9050	1 µmho/cm
Temperature	Thermometric	EP 170.1	0.2°C

(a) SW = Test Methods for Evaluating Solid Wastes (SW-846), Third Edition, EPA 1986b.

(b) The laboratory shall report, as estimated, MC in method blanks and samples detected below the quantification limit.

(c) EP = Methods for Chemical Analysis of Water and Wastes, EPA 1983.

## 8.0 DATA REDUCTION, VALIDATION, AND REPORTING

All analyses performed for the Project must be accompanied by sufficient QC results to enable reviewers to conclusively determine the quality of the data. The QAC or designee is responsible to the Field Services Project Manager for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the QC elements specified in this QAPjP.

Field measurements (photoionization detector, combustible gas indicator, groundwater level, pH, conductivity, and temperature) will be verified and checked through review of measurement and recording procedures during surveillance of field and instrumentation calibration procedures. Transfer of field data from field notebooks to raw data lists will be verified by the QAC.

Analytical data will be reported in the units specified in Table 7-1. These units have been selected to assure ease of comparison with previously generated relevant Site data and human health criteria.

The laboratory will provide documentation including the sample results with appropriate annotations, and all QA/QC results associated with that sample set (method detection limits, blanks, laboratory duplicates, matrix spikes, matrix spike duplicates, laboratory control samples, and surrogate recoveries). Raw data will not be required for all samples; however, the laboratory will maintain this information in their files. In addition, an interlaboratory comparison will be performed at a frequency of 5 percent of the samples. Data validation procedures for all samples will include checking the following:

- Holding times
- Field trip blanks
- Field rinsate blanks
- Field transfer blanks
- Blind field duplicates
- Laboratory duplicates
- Laboratory matrix spikes
- Laboratory matrix spike duplicates
- Method blanks

- QC check samples
- Surrogate recoveries
- Detection limits
- Assessment of precision
- Assessment of accuracy
- Assessment of completeness.

Section 12.0 presents statistical tests used to determine data precision, accuracy, and completeness. If precision or accuracy fall outside of established acceptance limits, reanalysis or corrective action will be implemented, as appropriate. All corrective action will be substantial and defensible, or the corrected data will not be used. Corrective action procedures are presented in Section 13.0.

## 9.0 INTERNAL QUALITY CONTROL

QC checks will consist of measurements performed in the field and laboratory. Analytical procedures referenced in Section 7.0 specify routine methods required to evaluate whether data are within proper QC limits. Additional QC checks include analysis of a number of field and laboratory QC samples, which are described in the following subsections.

### 9.1 FIELD/INTRALABORATORY METHODS

The following QC samples will be evaluated to verify accuracy and precision of analytical results for the Project. The frequency of laboratory and field QC analyses is described herein. The frequency of QC sample collection is specified on a percentage basis because the total number of samples collected during Phase II will depend on the number of groundwater monitoring wells, Site conditions (hydrogeology and contaminant distribution) at the time of installation, and the length of time required to complete the remedial action and post-remedial action monitoring.

#### 9.1.1 Field Trip Blank

The field trip blanks for groundwater sampling will consist of deionized (DI) or distilled water in a volatile organic compound sample container (supplied by the analytical laboratory), which will be transported to and from the field, then returned to the laboratory unopened and unaltered for volatile organics analysis to determine possible container contamination. One field trip blank will be included in each cooler containing groundwater samples.

#### 9.1.2 Field Rinsate Blank

A minimum of 5 percent of the total number of non-QC groundwater samples collected for volatile organic analyses using nondedicated sampling equipment will be collected and analyzed as field rinsate blanks. Field rinsate blanks will consist of DI or distilled water (supplied by the analytical laboratory) passed over and/or through decontaminated sampling equipment used to collect groundwater samples from wells not equipped with dedicated sampling equipment. Surfaces and materials exposed during actual sampling will be rinsed to evaluate the effectiveness of sampling equipment decontamination procedures and potential for equipment or field cross contamination.

### **9.1.3 Field Transfer Blank**

The field transfer blank will consist of DI or distilled water (supplied by the analytical laboratory) transferred to volatile organic compound sample containers in the field to determine possible sample contamination from the field. A minimum of 5 percent of the total number of non-QC groundwater samples will be collected and analyzed as field transfer blanks.

### **9.1.4 Blind Field Duplicate**

The field duplicate for groundwater sampling will consist of two water samples collected sequentially. Samples will be coded such that the laboratory cannot discern from the sample label which samples are duplicates. A minimum of 5 percent of the total number of non-QC groundwater samples collected will be analyzed for all analyses as blind field duplicates to provide information on the precision of chemical analysis.

### **9.1.5 Laboratory Matrix Spike**

Laboratory matrix spikes will be conducted to provide information on accuracy and assure that extraction and concentration levels are acceptable. These analyses will be conducted on a minimum of 5 percent of non-QC groundwater samples (or one per sampling event, if fewer than 20 samples are obtained). The laboratory matrix spike will follow EPA matrix spike guidelines specified in the EPA Method.

### **9.1.6 Laboratory Matrix Spike Duplicate**

Laboratory matrix spike duplicates will be analyzed for a minimum of 5 percent of non-QC groundwater samples (or one per sampling event if fewer than 20 samples are obtained). These analyses will be performed to provide information on the precision of chemical analysis. The laboratory matrix spike duplicate will follow EPA matrix spike duplicate guidelines specified in the EPA methods.

### **9.1.7 Laboratory Duplicates**

Laboratory duplicates will be conducted on a minimum of 5 percent of all non-QC groundwater samples to provide information on the precision of chemical analysis.



#### **9.1.8 Laboratory Method Blank**

Laboratory method blanks will be analyzed for a minimum of 5 percent of all non-QC groundwater samples (or one per batch of samples analyzed, if fewer than 20 samples are analyzed) to assess possible laboratory contamination. Dilution water will be used whenever possible. Laboratory method blanks will contain all reagents used for analysis.

#### **9.1.9 QC Check Sample**

QC check samples containing each analyte of interest will be analyzed for a minimum of 5 percent of non-QC groundwater samples or one per sampling event (if fewer than 20 samples are obtained) to verify the accuracy of laboratory equipment. Analysis will follow guidelines established in the EPA method. Procedure calibrations will substitute for QC check samples for chemical oxygen demand.

### **9.2 INTERLABORATORY COMPARISONS**

Interlaboratory comparisons will be conducted at a frequency of 5 percent of the non-QC groundwater samples submitted for analysis. Accuracy of the analyses will be evaluated based on the results of the blanks, matrix spikes, QC check sample analyses, and the interlaboratory results. A limited number of samples may be split with the EPA and/or Ecology, which will provide interlaboratory comparisons when analyzed.

## 10.0 PERFORMANCE AND SYSTEM AUDITS

This section presents the internal performance and systems audits required to monitor performance of the laboratory and field measurement systems. Performance and system audits of sampling activities and laboratory operations will consist of direct observations of work being performed, and inspection of laboratory and field equipment use, calibration, and maintenance to verify adherence to QA/QC requirements.

Internal audits of both field and laboratory activities will be conducted by the QAC or designee in accordance with the frequency established in Table 10-1. Audits will be unannounced to assure representative performance of technical and QA procedures.

Checklists for both field and laboratory audits will be based on EPA's National Enforcement Investigation Center audit checklists (EPA 1984b) as presented in Appendix B. The audit will be conducted only by individuals that have no direct responsibilities for the activities being audited.

Prior to internal audits, the auditor(s) will meet with the audited party to define the scope of the audit. The physical audit will consist of reviewing audited activities, completing the checklist, and noting any nonconformances, deficiencies, and relevant observations. An exit review will be conducted with the audited party to notify them of preliminary audit findings.

The auditor or designee will prepare an audit report that includes findings, nonconformances, observations, recommended corrective action, and a schedule for completion of such action. The Audit Report Format is presented in Table 10-2.

For each identified nonconformance, a Corrective Action Report (Figure 10-1) will be issued as part of the audit report by the auditor to notify the responsible party (the individual responsible for implementing corrective action) of the recommended corrective action and its schedule for completion (see Section 13.0). If a field corrective action is required, the Field Coordinator will be notified. If a laboratory corrective action is required, the Laboratory QA Officer will be notified. The audit report will be distributed to the Spokane County Project Manager and Field Services Project Manager.

The audit will remain open until all corrective action is completed by the responsible party and approved by the QAC. Once all findings are corrected and documented on Corrective Action Reports, the audit will be closed by the QAC. Closure may be effected by either a memo to be filed with the audit report or by another appropriate method. The audit reports and associated Corrective Action Reports will be submitted to Ecology and EPA once the audit is closed.

## Corrective Action Report

Sample Program Identification: \_\_\_\_\_

Sampling Dates: \_\_\_\_\_

Material to be Sampled: \_\_\_\_\_

Measurement Parameter: \_\_\_\_\_

Acceptable Data Range: \_\_\_\_\_

Corrective Actions Initiated By: \_\_\_\_\_

Title: \_\_\_\_\_ Date: \_\_\_\_\_

Problem Areas Requiring Corrective Action: \_\_\_\_\_

Measures to Correct Problems: \_\_\_\_\_

Means of Detecting Problems (field observations, systems audit, etc.) \_\_\_\_\_

Approval for Corrective Actions: \_\_\_\_\_

Title: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_

TABLE 10-1  
SCHEDULE OF AUDIT ACTIVITIES

Activity	Frequency	Auditor
Field Sampling <sup>(a)</sup>	Once/year	QAC
Laboratory Analysis <sup>(a)</sup>	Once/2 years <sup>(b)</sup>	QAC

(a) Audit to cover documentation, sample handling, and measurement procedures.

(b) Within first two weeks after sample submittal.

TABLE 10-2  
AUDIT REPORT FORMAT

- 
1. Purpose of Audit
  2. Audit Basis
  3. Time and Place of Audit
  4. Personnel Contacted
  5. Audit Team Members
  6. Summary of Events
  7. Findings and Recommendations
    - a. Positive Findings
    - b. Negative Findings
  8. Required Follow-up (responsible parties, summary of required corrective action, date of reaudit, if required)
  9. Distribution of Audit Report and Corrective Action Reports.

## **11.0 PREVENTIVE MAINTENANCE**

### **11.1 FIELD INSTRUMENTS**

The field representative is responsible for field instrumentation preventive maintenance for instrumentation utilized by that individual. Preventive maintenance on field instruments will be performed by qualified field technicians in accordance with manufacturer's instructions and maintenance schedules. Maintenance will be documented in instrument log books, and will include the date and initials of individual performing the maintenance.

The field representative will routinely compare instrument calibration results against preventive maintenance records to verify the effectiveness of the preventive maintenance program. The field representative is responsible for scheduling preventive maintenance required by the manufacturer.

### **11.2 LABORATORY INSTRUMENTS**

The analytical laboratory manager has ultimate responsibility for maintaining laboratory instruments in good working order, including responsibilities for routine maintenance and the training of personnel in maintenance procedures. All maintenance activities and other appropriate details will be documented daily in maintenance log books by the laboratory personnel performing the maintenance. Each entry will be signed and dated. At a minimum, the preventative maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

## 12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Analytical data will be reviewed to assure that the QA/QC objectives for precision, accuracy, and completeness are met. These reviews are intended to identify the occurrence of deficiencies in time to take corrective action. This section describes routine procedures for assessing Project data.

### 12.1 ASSESSMENT OF PRECISION

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that test precision include field duplicates, laboratory duplicates, and laboratory matrix spike duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), and is calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where  $D_1$  = First sample value

$D_2$  = Second sample value (duplicate)

The RPDs will be routinely calculated and compared with DQOs.

To set control limits, the standard deviation,  $s$ , of a series of replicate measurement limits is calculated:

$$s = \sqrt{\sum_{i=1}^n \left[ \frac{(X_i - \bar{X})^2}{n-1} \right]}$$

Where:  $s$  = the sample standard deviation

$n$  = the number of replicates

$X_i$  = the  $i$ th replicate

$\bar{X}$  = the mean of the replicates

## 12.2 ASSESSMENT OF ACCURACY

Accuracy is assessed using results of QC check samples and laboratory matrix spike analyses, and is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against DQOs.

## 12.3 ASSESSMENT OF COMPLETENESS

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with DQOs.



### 13.0 CORRECTIVE ACTIONS

Corrective actions may be needed for three categories of non-conformance:

- Deviations from the methods or QA requirements established in the QAPjP
- Measuring or analytical equipment malfunctions
- Analytical error.

Corrective action procedures that might be implemented based on audit results or detection of unacceptable data are developed on a case-by-case basis. Such actions may include one or more of the following:

- Altering procedures in the field
- Using a different batch of containers
- Performing an additional audit of field or laboratory procedures
- Reanalyzing samples if holding times allow
- Resampling and analyzing
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies
- Accepting the data with no action, acknowledging the level of uncertainty
- Rejecting the data as unusable.

During field operations and sampling procedures, the field representative will be responsible for taking and reporting required corrective action related to field activities. A description of any such action taken will be entered in the Field Log Book. If field conditions are such that conformance with the QAPjP is not possible, the QAC will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPjP or Field Sampling Plan will be communicated to the County Project Manager as well as the EPA and Ecology for review and concurrence. This communication will be made prior to changes in the field activities whenever possible.

During laboratory analysis, the Laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet DQOs outlined in this QAPjP, corrective action will follow the guidelines in the EPA methods

and the EPA guidelines for data validation for organics and inorganics (EPA 1988a,b, 1991). At a minimum, the Laboratory QA Officer will be responsible for monitoring the following:

- Calibration check compounds must be within performance criteria specified in the EPA method or corrective action must be taken prior to initiation of sample analysis. For volatile organics analysis in water (Method 8010), a minimum of five calibration standards will be prepared for each analyte of interest. One of the standards should be at a concentration near, but above, the method quantification limit. The other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. The percent relative standard deviation cannot exceed 20 percent when comparing calibration factors to determine if the five-point calibration curve is linear. The working calibration curve or calibration factor must be verified on each working day by the injection of one or more calibration standards. If the response for any analyte varies from the predicted response by more than  $\pm 15$  percent, a new calibration curve must be prepared for that analyte. No analyses may be performed until these criteria are met.
- Before processing any samples, the analyst should demonstrate, through analysis of a reagent blank, that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

For volatile organics analysis in water, blanks must contain less than 1.0  $\mu\text{g/L}$  methylene chloride. The laboratory should report the methylene chloride concentration as estimated, "J", if below the 1.0  $\mu\text{g/L}$  limit. For other parameters, method blanks must be below criteria guidelines specified in the method. If contaminants are present above these levels, the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank re-analyzed. If, upon re-analysis, blanks do not meet these requirements, the QAC will be notified immediately to discuss whether analyses may proceed.

- Retention time windows will be defined by plus or minus three times the standard deviation of the absolute retention times for each standard. The laboratory must calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. The data must be retained by the laboratory. All succeeding standards in an analysis sequence must fall within the daily retention time window established by the first standard of the sequence. No analyses may proceed until this criterion is met.
- Matrix spike analysis for volatile organics must be within the specified range for recovery limits or corrective action must be taken and documented. Corrective action includes: 1) reviewing calculations, 2) checking surrogate solutions, 3) checking internal standards, and 4) checking instrument performance. Subsequent action could include recalculating the data and/or

re-analyzing the sample if any of the above checks reveal a problem. If the problem cannot be corrected through re-analysis, the QAC will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate.

If the recovery of a surrogate compound in the method blank is outside the recovery limits, the blank will be re-analyzed along with all samples associated with that blank. If the surrogate recovery is still outside the limits, the QAC will be notified immediately to discuss whether analyses may proceed.

- If holding times are exceeded, all positive and non-detected results will be qualified as estimated concentrations. If holding times are grossly exceeded, the QAC may determine the data to be unusable.
- If laboratory instrumentation deviates from required calibration specifications, the QAC will either flag data as estimated or determine it to be unusable, according to guidelines established by EPA (EPA 1988a,b, 1991).

If analytical conditions are such that non-conformance with this QAPjP is indicated, the QAC will be notified as soon as possible, so that any additional corrective actions can be taken.

Corrective Action Reports (Figure 10-1) will be used to document response to reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of Project activities (Section 10.0).

Corrective Action Reports initially will be reviewed for appropriateness of recommendations and actions by the QAC (for QA matters) and by the Project Manager (for technical approach). The reports will then be forwarded to the County Project Manager for review.

#### **14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT**

All data packages submitted to the EPA and Ecology will include a QA report containing results of the QA workups and conclusions. This QA report will summarize all relevant data quality information. The QAC will be responsible for data quality assessments and associated QA reports.

QA audit reports will be prepared and submitted to the Project Manager and the County Project Manager. Final task or investigative reports will contain a separate QA section summarizing data quality information.

## 15.0 REFERENCES

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APPENDIX A

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## Field Sampling Plan



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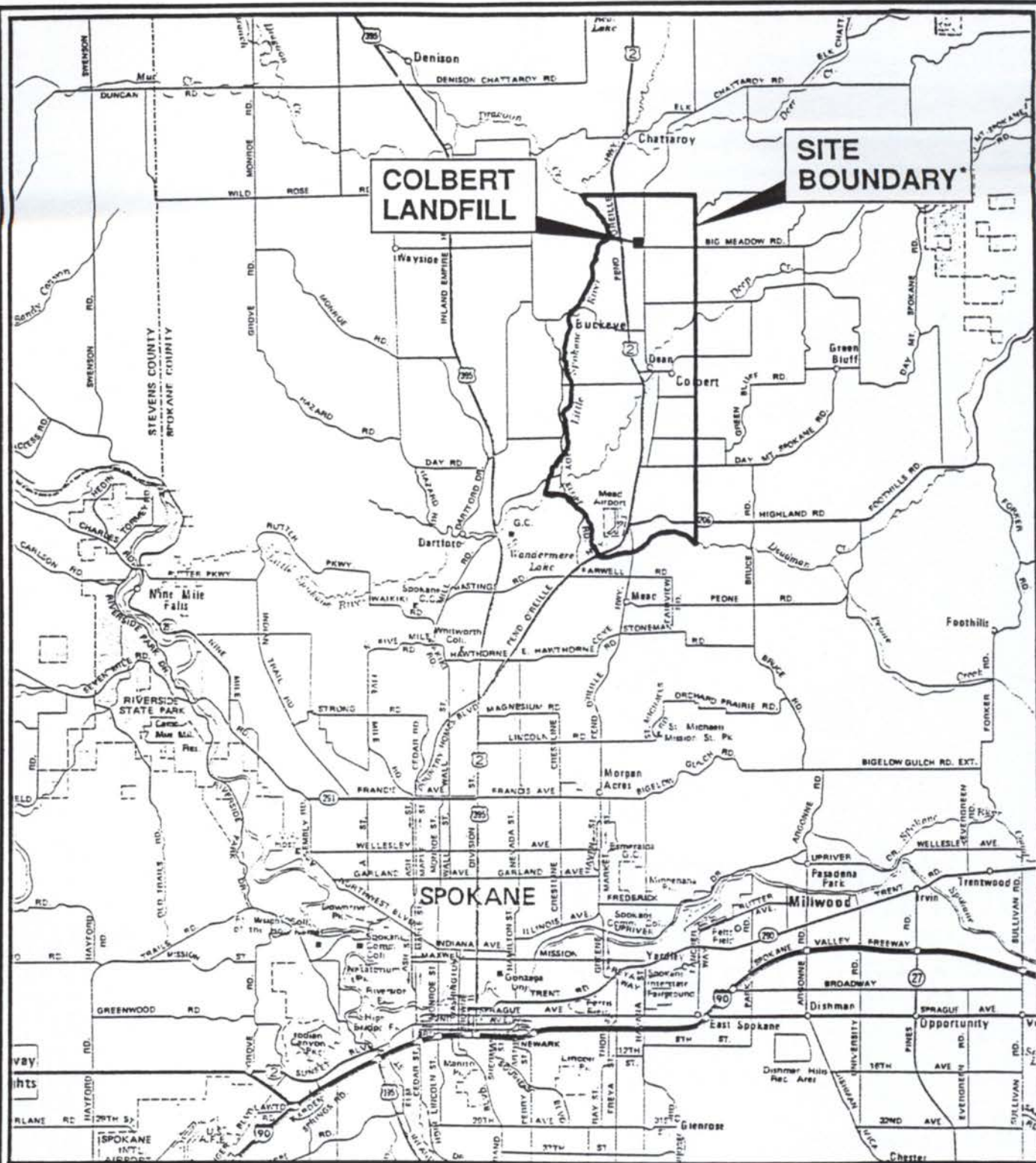
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## 1.0 INTRODUCTION

This Field Sampling Plan (FSP) has been prepared in conjunction with the Quality Assurance Project Plan (QAPjP) to address Phase II Remedial Design/Remedial Action (RD/RA) project (Project) sampling activities at the Colbert Landfill Superfund Site (Site). The QAPjP should be referred to for a discussion of the Site history and Project background. A regional location map of the Colbert Landfill vicinity is provided on Figure A-1-1.

The purpose of the FSP is to provide detailed information on the procedures to be implemented when collecting Phase II groundwater, soil, and influent/effluent samples at the Site. These field sampling procedures are intended to provide data that meets the data quality objectives (DQOs) established in Sections 1.0 and 3.0 of the QAPjP, and will be conducted in accordance with the quality assurance/quality control (QA/QC) requirements of the QAPjP.

The FSP provides a general description of sampling frequency. However, the Project remedial action is anticipated to require at least 30 years and sampling frequency will vary, depending on observed conditions during remedial action, based on the operational sampling frequency criteria specified in the Project Consent Decree Scope of Work (SOW) (Section V). Operational groundwater and influent/effluent sampling frequency, and criteria for modifying sampling frequency, will be presented in the Project operation and maintenance manual.



\* As specified in the ROD (EPA 1987)



Regional Location Map

Figure A-1-1

A-1-2

## 2.0 SAMPLING OBJECTIVES

The objective of the FSP is to assure that accurate, reproducible, and comparable data are acquired during Phase II of the Project. To achieve this objective, this document details sample collection, handling, documentation, and security procedures. These procedures have been written to comply with the *Compendium of Superfund Field Operations* (EPA/540/P-87/ 001, OSWER 9355.014, September 1987). Standards have been developed for evaluation of the field sampling procedures with respect to the Project objectives.

Any changes in sampling procedures as outlined in this document will be described on the Modification to Field Sampling Plan form (Form A-2-1). Approval from the Field Services Project Manager will be needed prior to implementation of any changes.

# Modification To Field Sampling Plan

Sample Program Identification: \_\_\_\_\_

Material to be Sampled: \_\_\_\_\_

Measurement Parameter: \_\_\_\_\_

Standard Procedure for Analysis: \_\_\_\_\_

Reference: \_\_\_\_\_

Variation from Standard Procedure: \_\_\_\_\_

Reasons for Variation: \_\_\_\_\_

Special Equipment, Material or Personnel Required: \_\_\_\_\_

Author's Name: \_\_\_\_\_

Approval: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

Comments: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

Comments: \_\_\_\_\_

### 3.0 SAMPLING LOCATION, ANALYSIS, AND FREQUENCY

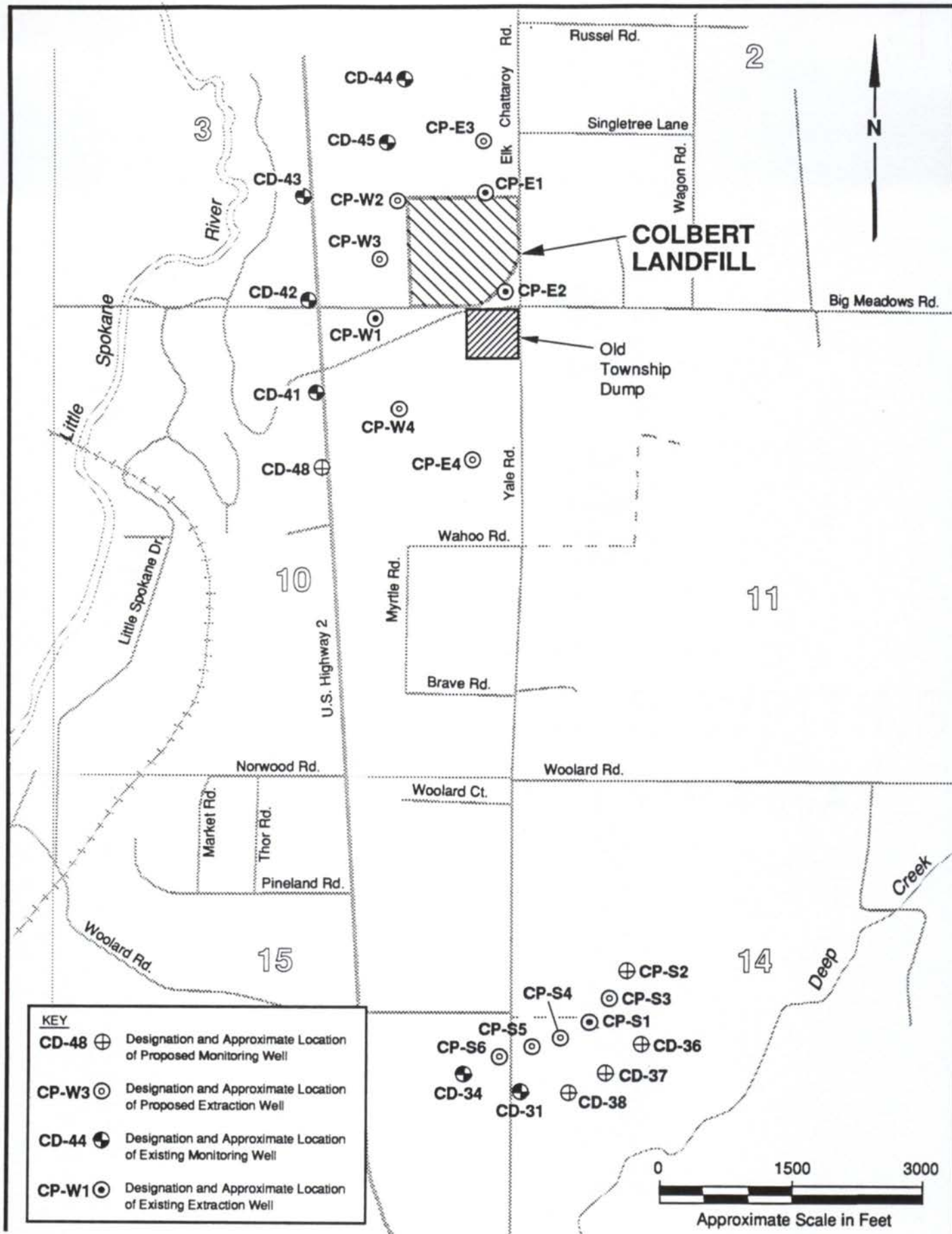
Groundwater, soil, and treatment system influent/effluent samples will be collected and analyzed for selected parameters during Phase II of the Project. Phase II sampling and analysis will be conducted as follows:

- Soil: to be collected from the boreholes of 11 proposed Phase II monitoring wells and 9 proposed Phase II extraction wells (at 5- to 10-ft intervals) to supplement Phase I geologic/hydrogeologic site characterization and to assist in well screen design; no chemical analysis of soil samples will be conducted in Phase II
- Groundwater: to be collected from 11 proposed and 13 existing monitoring wells and from 9 proposed and 4 existing extraction wells; initial sampling to provide supplemental groundwater characterization data (including constituent distribution) to support and (as required) refine the Phase I assessments of constituent plume migration and areal extent; operational sampling to evaluate interception system performance and remedial action progress; groundwater samples will be analyzed for the Constituents of Concern, pH, specific conductivity, and temperature
- Influent/Effluent: to be collected from the intake and discharge sides of the treatment system (stripping tower) to provide data on the effectiveness of the treatment system in reducing concentrations of the Constituents of Concern to levels specified in the Consent Decree, (in the case of effluent) to provide data on selected physical water quality parameters to assess system compliance with National Pollution Discharge Elimination System (NPDES) requirements governing industrial discharges to surface receiving waters, and to determine treatment system air emissions (by groundwater influent/effluent mass balance).

Existing and proposed Phase II groundwater monitoring well and extraction well locations comprising the Phase II sampling network are shown on Figure A-3-1. Constituents/parameters to be analyzed (for each sampling type and matrix) and the frequency of sampling, are presented in Table A-3-1. In addition to parameters and constituents indicated in Table A-3-1, influent/effluent samples will be regularly monitored for pH, specific conductivity, and temperature by either mechanical or electronic means.

The number of wells at each Phase II monitoring location is provided in Table A-3-2 (only one well is present at each extraction well location).





Location of Phase II Monitoring and Extraction Wells

Figure A-3-1



TABLE A-3.1

PHASE II SAMPLING AND ANALYSIS PROGRAM  
COLBERT LANDFILL REMEDIAL DESIGN/REMEDIAL ACTION<sup>(a)</sup>

Project Activity	Sample Type and Location	Total No. of Samples	Purpose of Sampling	Matrix	Analysis	Frequency
Geologic/Hydrogeologic Characterization (Soil Sampling)	Borehole Samples <sup>(b)</sup>					
	South System (8 wells) <sup>(c)</sup> 100-120 ft deep	80-192	- Visual observation/ logging of geologic/ hydrogeologic units	Soil	- Physical testing, including one or more of the following: grain size analysis (ASTM D422-63), moisture content (ASTM D-2216-80), and unit weight (ASTM D2937-83) on approximately 1-3 samples from each location	About every 5 to 10 ft during boring advancement
	West System (10 wells) <sup>(d)</sup> 200-400 ft deep	300-600	- Physical testing for screen design			
	East System (2 wells) <sup>(e)</sup> 200-250 ft deep	<u>40-100</u> 420-892				
Interception System Performance Monitoring/Groundwater Characterization (Groundwater Sampling)	Monitoring Well Samples					
	South System (6 wells)	6	- Performance monitoring of South and West Interception Systems	Groundwater	- Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) (Method SW 8010)	Once after development, and monthly, quarterly, or annually thereafter, based on (Section V) SOW requirements
	West System (18 wells)	18				
	East System (N/A)	0	- Characterize Constituents of Concern in target aquifer		- Field measurements of pH (Method SW 9040), specific conductivity (Method SW 9050), and temperature (Method EP 170.1)	
Operational Evaluation/Groundwater Characterization (Groundwater Sampling)	Extraction Well Samples					
	South System (5 wells)	5	- Evaluate concentration dependent operational alternatives (per Section V of SOW)	Groundwater	Same as for monitoring well samples	At Spokane County's discretion
	West System (4 wells)	4				
	East System (4 wells)	4	- Characterize Constituents of Concern in target aquifer			
Treatment System Assessment (Influent/Effluent Sampling)		13 per sampling event; or up to about 1,500 samples over life of the project <sup>(f)</sup>				
	Treatment System (stripping tower)	14 daily and 4 weekly samples during initial startup; up to 400 total monthly samples for the 30-year life of the project	- Evaluate treatment system efficiency - Evaluate concentration- dependent treatment alternatives (per Section V of the SOW) - Evaluate effectiveness of scale control measures - Evaluate mass removal of Constituents of Concern	Groundwater (Influent)	- Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) (Method SW 8010); hard- ness (Method EP 130.2); alkalinity (Method EP 310.1) - Field measurement of pH (Method SW 9040), specific conductivity (Method SW 9050), and temperature (Method EP 170.1)	Daily for 2 weeks, then weekly for the 4 weeks of initial treatment system operation. Monthly thereafter.
	Influent samples					

A-3-3

TABLE A-3.1

PHASE II SAMPLING AND ANALYSIS PROGRAM  
COLBERT LANDFILL REMEDIAL DESIGN/REMEDIAL ACTION<sup>(a)</sup>

Project Activity	Sample Type and Location	Total No. of Samples	Purpose of Sampling	Matrix	Analysis	Frequency
	Treatment System (stripping tower) Effluent Samples	Same as for influent samples	<ul style="list-style-type: none"> <li>- Verify effluent meets SOW Evaluation Criteria for volatile organic Constituents of Concern (Table IV-1)</li> <li>- Evaluate treatment system efficiency</li> <li>- Evaluate effectiveness of scale control measures</li> <li>- Meet NPDES discharge monitoring requirements</li> <li>- Evaluate mass removal of Constituents of Concern</li> </ul>	Groundwater (Effluent)	<ul style="list-style-type: none"> <li>- Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) (Method SW 8010)</li> <li>- BOD (Method EP 405.1); COD (Method EP 410.4); TDS (Method EP 160.1); TSS (Method EP 160.2); TOC (Method SW 9060); phosphorous (Method EP 365.1); hardness (Method EP 130.2); alkalinity (Method 310.1)</li> <li>- Field measurement of pH (Method SW 9040); specific conductivity (Method SW 9050); temperature (Method EP 170.1)</li> </ul>	Same frequency as for influent sampling

- (a) This table presents only that sampling required by the Consent Decree; Spokane County has the option to conduct additional discretionary groundwater sampling and analysis in Phase II.
- (b) From monitoring and extraction well borings.
- (c) Includes soil sampling at 4 new monitoring wells and 5 new extraction wells; see Figure FS-3.1.
- (d) Includes soil sampling at 3 new monitoring wells and 4 new extraction wells; see Figure FS-3.1.
- (e) Includes soil sampling at 2 new extraction wells; see Figure FS-3.1.
- (f) Estimated based on quarterly sampling. Sampling is at Spokane County's discretion.

A-3-4

TABLE A-3.2  
NUMBER OF NEW AND EXISTING WELLS  
AT EACH PHASE II GROUNDWATER MONITORING LOCATION

Well Location	Number of Existing Wells	Number of New Wells <sup>(a)</sup>
CD-31	1	0
CD-34	1	0
CD-36	0	1
CD-37	0	1
CD-38	0	1
CD-41	3	0
CD-42	3	0
CD-43	3	0
CD-44	1	2
CD-45	1	2
CD-48	0	3
CP-S2 <sup>(b)</sup>	0	1
Total	13	11

(a) Wells to be constructed during Phase II.

(b) CP-S2 will be constructed for possible conversion to an extraction well.

## 4.0 SAMPLE COLLECTION AND ANALYSIS PROCEDURES

This section presents descriptions of the equipment and step-by-step procedures to be used for collecting, handling, and analyzing Phase II groundwater (Section 4.1), treatment system influent and effluent (Section 4.2), and subsurface soil samples (Section 4.3). A summary of sample containers, preservation requirements, and holding times is presented in Table A-4-1.

### 4.1 GROUNDWATER MONITORING/EXTRACTION WELL SAMPLING

During Phase II activities, groundwater samples will be collected from monitoring wells and extraction wells. Groundwater samples will be analyzed for Constituents of Concern (1,1,1-TCA, 1,1-DCE, 1,1-DCA, methylene chloride, TCE, and PCE) using Method 8010, and other inorganic and physical parameters (see Section 3.0).

Groundwater monitoring well and extraction well sampling will be conducted in accordance with the procedures described in the following subsections. Dedicated sampling equipment will be installed in all Phase II monitoring and extraction wells; however, some pre-existing monitoring wells that are not part of the Phase II groundwater monitoring system do not have dedicated sampling equipment. Therefore, this section will present sampling procedures for both dedicated and nondedicated sampling equipment.

#### 4.1.1 Water Level Measurements

Water levels will be measured with an electronic water level indicator just prior to purging and sampling. Measurements will be from the surveyed point on the top of the PVC well casing. If a nondedicated water level probe is used, it will be decontaminated before and after each measurement with a distilled water rinse. Depth to water will be recorded to the nearest 0.01 ft on the Sample Collection Form (Form A-4-1).

#### 4.1.2 Purging the Well

Prior to sampling, the well will be purged by removing at least three well volumes of water from the casing using an air-driven, piston, or bladder pump fitted with teflon-lined polyethylene or stainless steel tubing (a submersible pump may be used for pilot extraction wells). If the pump is nondedicated (as is the case for certain monitoring wells), the interior of the tubing and the pump will be washed with an Alconox and water solution, rinsed with tap water, and then rinsed with distilled or deionized water following use. The exterior of the

tubing will be decontaminated with a high-pressure, hot water pressure washer. During decontamination, rinse water will not be allowed to drip onto the plastic sheeting under the decontaminated pump and tubing.

The well purge volume will be calculated based on the following formula: one well volume (gallon) =  $\pi r^2 h \times 7.48 \text{ gal/ft}^3$ ; where  $\pi = 3.14$ ,  $r$  = radius of well casing in feet,  $h$  = height of water column from the bottom of the well in feet. Well depth measurements will be obtained after well installation and will be provided to the groundwater sampling team. Information on purge volume, date and time of initiation, and termination of pumping, plus a description of the physical characteristics of purge water (color, turbidity, etc.) based on visual observation, will be recorded on the Sample Collection Form (Form A-4-1). In most instances, sampling will be completed the same day as well purging. However, if the well becomes dry during purging, it will be sampled as soon as the water level has recovered enough to allow collection of the necessary samples, which may require sampling on a subsequent day. The start and end date and time of purging, and the date and time of sample collection, will be recorded on the Sample Collection Form.

#### 4.1.3 Groundwater Sampling Equipment

Groundwater samples will be collected with the aid of a bladder pump, piston pump, or a stainless steel or teflon bailer (a submersible pump may be used for extraction wells). If the pump or bailer is nondedicated, it will be decontaminated by washing with an Alconox and water solution, then rinsing with tap water, and rinsing with distilled or deionized water following use. During decontamination, rinse water will not be allowed to drip onto the plastic sheeting under the decontaminated pump and tubing. The pump (or bailer) will also be rinsed with distilled or deionized water prior to use at a new location.

The following precautions will be followed when using a nondedicated pump or bailer to collect groundwater samples:

- Between decontamination and placement in the well, the pump or bailer will not contact any surface except the inside of a clean carrying case
- The pump or bailer will be lowered slowly into the well
- The pump or bailer will not be allowed to come into contact with any surface other than the inside of the well casing.

#### **4.1.4 Sample Containers**

Certified sample containers that have been cleaned to EPA specifications will be obtained through the analytical laboratory; the laboratory will add the proper preservatives to the appropriate containers prior to sample collection.

#### **4.1.5 Sample Labels**

Sample labels are necessary to properly identify samples. Gummed paper labels or tags are adequate for the anticipated Phase II activities and will include the following information:

- Sample identification number
- Date and time
- Name of sampler
- Pertinent field information.

Labels will be completed and affixed to sample containers prior to or at the time of sampling.

#### **4.1.6 Field Measurements**

##### **4.1.6.1 Calibration**

Conductivity and pH meters will be calibrated following the manufacturer's procedures provided with the instruments (Appendix B). These meters will be calibrated prior to sampling each well, or at least once for every four hours of sampling. Calibration adjustments will be recorded in a log book maintained for each meter. After each sample is collected, the calibration will be checked by measuring the pH 7 buffer solution and recording that reading and the buffer temperature on the Sample Collection Form. If readings are within 0.1 pH units of the pH 7 buffer, no recalibration is needed.

##### **4.1.6.2 Measurements**

Four replicate field measurements of pH and conductivity will be made using the following procedure:

- Rinse a 250 ml plastic beaker three times with sample water
- Rinse the electrode, dip cell, and temperature compensation probe by storing them in sample water for at least one minute
- Set the automatic temperature compensator to the "on" position

- Fill the beaker with sample water; place the probes in the beaker for 1-2 minutes or until the reading stabilizes. Read the temperature, pH, and conductivity measurements and record on the Sample Collection Form
- Measure and record three additional sample replicates by repeating this last step; rinse beaker with sample water to be measured between each measurement
- Note any problems or significant observations in the "comments" section of the Sample Collection Form (Form A-4-1).

#### **4.1.7 Filling Sample Bottles**

During sample collection from wells, sample bottles will be filled directly from the baller or pump, and will be filled with a minimal amount of air contact when sampling for volatile organic Constituents of Concern. A slow, steady pumping rate will be used during sample collection.

The following procedures and precautions will be adhered to when filling sample bottles:

- Bottle caps will be removed carefully so that the inside of the cap is not touched. Caps will not be placed on the ground. Caps for volatile organics analyses contain a teflon-lined septum. The teflon side of the septum must be facing the sample to prevent contamination of the sample through the septum.
- The sample bottles will be filled with a minimal amount of air contact and without allowing the sampling equipment or personnel to contact the inside of the bottles. Tubing or hoses from pumps or sampling nozzles will not be placed into the sample bottles.
- Sample bottles containing preservatives should be filled completely. Bottle caps should be replaced tightly.
- Vials for volatile organics analyses will be filled so that they are headspace-free (i.e., no air bubbles in the sample bottle). The caps will be replaced gently, so as to eliminate any air bubbles in the sample. These bottles will then be checked for air bubbles by inverting them and shaking the bottle. If any air bubbles appear, the bottles will be reopened, topped off, and recapped. If an air bubble is present after topping off, the bottle will be emptied and refilled.
- Each pair of volatile organics analyses sample bottles will be placed in a plastic bag. Samples should be placed into an ice chest immediately after collection to prevent loss of volatile organics through exposure to sunlight and warm temperatures.

#### **4.1.8 Monitoring/Extraction Well Sample Quality Control (QC)—Volatile Organics Analyses**

Approximately 25 percent of the total number of monitoring/extraction well samples will be collected as QC samples. The four types of field QC samples that will be collected for volatile organic Constituents of Concern analyses are: 1) rinsate blank, 2) field duplicate, 3) transfer blank, and 4) trip blank. Whenever possible, every tenth sample will be either a duplicate or a transfer blank. Trip blanks will accompany each ice chest containing groundwater samples for volatile organic analyses. The types of field QC samples are described below:

- **Rinsate Blanks:** For wells that are not equipped with dedicated sampling equipment, a minimum of 5 percent of the total number of non-QC groundwater samples (collected from monitoring and extraction wells without dedicated sampling equipment) for VOA will be collected as rinsate blanks to check equipment decontamination procedures. Rinsate blanks will be collected following sampling from wells which are expected to contain relatively high concentrations of volatile organics. Equipment rinsate blanks will be prepared without making any special effort when decontaminating the sampling equipment. The rinsate blank will consist of deionized/distilled water poured over the cleaned sampling equipment and collected into septum vials (appropriately sized containers) for laboratory analysis.
- **Field Duplicate Samples:** A minimum of 5 percent of the total number of water samples will be collected and analyzed as field duplicates. At a minimum, one duplicate will be collected from each of the South and West Interception and East Extraction Systems during Phase II sampling. Duplicate samples will be collected by alternately discharging the pump or bailer into duplicate sample bottles. Each duplicate sample will have a separate sample number and Sample Collection Form so that laboratory personnel will not know the sample is a duplicate.
- **Transfer Blanks:** A minimum of 5 percent of the total number of water samples will be sent to the laboratory as transfer blanks. A transfer blank will be collected by transferring deionized (DI)/distilled water, provided by the analytical laboratory, into a set of sample bottles. Each transfer blank will be identified and logged on a separate Sample Collection Form. Upon return to the laboratory, the transfer blank will be analyzed as if it were a field sample, following the same QA/QC procedures as ordinary samples.
- **Trip Blanks:** One trip blank will be included in each ice chest containing groundwater samples. A trip blank will consist of a sample bottle filled with deionized/distilled water by the analytical laboratory. The blank will remain with the sample bottles in transit to and around the site during sampling and the return trip to the laboratory. At no time during these sampling activities is the trip blank to be opened. Upon return to the laboratory, the trip blank will be analyzed as if it were another field sample receiving the same QA/QC procedures as ordinary samples. If no volatile organic constituents are detected in any sample in a ice chest, the accompanying trip blank need not be analyzed.



#### **4.1.9 Chain of Custody**

To establish the documentation necessary to trace sample possession from the time of collection, a Chain-of-Custody Record similar to that shown on Form A-4-2 will be filled out and will accompany every sample delivery to the laboratory. The record will contain the following information:

- Sample identification number
- Name of sampler
- Date and time of collection
- Signature of persons involved in the chain of possession (the sampler will be the first person to relinquish custody)
- Inclusive dates of possession.

The Chain-of-Custody Record will be completed in duplicate for all sampling. Copies of the completed Chain-of-Custody Records will be retained by the analytical laboratory, in the project files, and by the QA Coordinator (QAC). The laboratory will include a copy of the Chain-of-Custody Record in its report of analytical results.

#### **4.1.10 Chain-of-Custody Seal**

A Chain-of-Custody Seal similar to that shown on Form A-4-3 (used to detect unauthorized tampering with the samples) will be placed on the ice chest after collection of all samples and whenever samples are left unattended. The seal will include, at a minimum, the sampler's name and the date. The seal will be attached such that it must be broken in order to open the ice chest. The seals will be affixed to the ice chest before the sampling personnel relinquish custody of the samples.

#### **4.1.11 Field Records**

Field log books, plus the Sample Collection Forms, will be used to record all information pertinent to the field survey of the sampling event. The records will contain sufficient information to permit reconstruction of sampling events without reliance on the sampler's memory. All field log books and forms will be retained by the Field Coordinator and secured in a safe place.

#### **4.1.12 Shipment of Samples**

A Sample Analysis Request Packing List (Form A-4-4) will accompany the samples to the laboratory. This form will be completed by field personnel and will specify the analysis to be performed by the analytical laboratory. Samples will be shipped to the laboratory within 24 hours of sampling, except as noted in Section 5.0 for samples collected on Friday.

The samples will be accompanied by a Chain-of-Custody Record and will be delivered to the laboratory representative authorized to receive samples. The laboratory representative will sign the Chain-of-Custody Record to verify delivery/receipt. Further instructions on sample packaging and shipping are outlined in Section 5.0.

### **4.2 TREATMENT SYSTEM INFLUENT/EFFLUENT SAMPLING**

Samples of treatment system influent/effluent will be collected and analyzed during Phase II Project activities to evaluate the efficiency of the treatment system in removing the Constituents of Concern (1,1,1-TCA, 1,1-DCE, 1,1-DCA, methylene chloride, TCE, and PCE). In addition, influent/effluent will be analyzed for selected physical parameters [total dissolved solids (TDS), alkalinity, and hardness], as well as periodically monitored (either electronically or mechanically) for pH, specific conductivity, and temperature. Influent/effluent will be sampled and analyzed for the volatile organic Constituents of Concern using Method 8010. Effluent samples will also be sampled and analyzed to evaluate system compliance with NPDES requirements. NPDES parameters analyzed will potentially include biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total organic carbon (TOC), and phosphorous (as P), in addition to pH and temperature. Stripping tower influent/effluent sampling will be performed in accordance with the procedures described in the following subsections.

#### **4.2.1 Sample Collection Procedures**

Samples of stripping tower influent/effluent will be collected using the same procedures described in Sections 4.1.4 through 4.1.7 for groundwater monitoring wells; except stripping tower influent/effluent samples will be collected from access ports located on (or adjacent to) the treatment facility, so sampling equipment will not be needed.

#### **4.2.2 Treatment System Quality Control (QC) Samples**

Approximately 20 percent of the total number of treatment system influent/effluent samples will be collected as QC samples. Whenever possible, every tenth sample will be either a duplicate or blank, and will be collected in the following order: 1) duplicate, 2) transfer blank, and 3) trip blank. Rinsate blanks will not be collected because samples will be collected from dedicated equipment (i.e., sample ports permanently installed on the stripping tower). The types of field QC samples are described below:

- **Field Duplicate Samples:** A minimum of 5 percent of the total number of influent/effluent samples will be collected and analyzed as a field duplicate sample. Field duplicate samples will be collected by alternately filling duplicate sample bottles. Each duplicate sample will have a separate sample number and Sample Collection Form so that laboratory personnel do not know the sample is a duplicate.
- **Transfer Blanks:** A minimum of one percent transfer blank will be collected every twentieth sample by transferring DI/distilled water, provided by the analytical laboratory, into a set of sample bottles. Each transfer blank will be identified and logged on a separate Sample Collection Form. Upon return to the laboratory, the transfer blank will be analyzed as if it were a field sample, following the same QA/QC procedures as ordinary samples.
- **Trip Blanks:** A trip blank will accompany each ice chest containing stripping tower samples. A trip blank will consist of a sample bottle filled with DI/distilled water by the laboratory. The blank will remain with the sample bottles in transit to and around the site during sampling and the return trip to the laboratory. At no time during these sampling activities is the trip blank to be opened. Upon return to the laboratory, trip blanks will be analyzed for at least 1 out of every 5 sampling events (about 10 percent of the total number of influent/effluent samples). Additionally, the trip blank will be analyzed if anomalously high concentrations are reported by the laboratory for the associated effluent sample. The trip blank is analyzed as if it were another field sample following the same QA/QC procedures as ordinary samples.

#### **4.2.3 Chain of Custody**

To establish documentation necessary to trace sample possession from the time of collection, a Chain-of-Custody Record similar to that shown on Form A-4-2 will be completed and will accompany every sample delivery to the laboratory. The record will contain the following information:

- Sample identification number
- Name of sampler

- Date and time of collection
- Signature of persons involved in the chain of possession (the sampler will be the first person to relinquish custody)
- Inclusive dates of possession.

The Chain-of-Custody Record will be completed in duplicate. Copies of the completed Chain-of-Custody Records will be retained by the analytical laboratory, in the Landau project files, and by the QAC. The laboratory will include a copy of the Chain-of-Custody Records in its report of analytical results.

#### **4.2.4 Chain-of-Custody Seal**

A Chain-of-Custody Seal similar to that shown on Form A-4-3 (used to detect unauthorized tampering with the samples) will be placed on the ice chest after the collection of all samples. The seal will include, at a minimum, the sampler's name and the date. The seal must be attached such that it must be broken in order to open the ice chest. Seals must be affixed to the ice chest before the sampling personnel relinquish custody of the samples.

#### **4.2.5 Field Records**

Field log books, plus the Sample Collection Forms, will be used to record all information pertinent to the sampling event. The records will contain sufficient information to permit reconstruction of sampling events without reliance on the sampler's memory. All field records will be retained by the Field Coordinator and secured in a safe place.

#### **4.2.6 Shipment of Samples**

A Sample Analysis Request Packing List (Form A-4-4) will accompany the samples to the laboratory. This form will be completed by field personnel and will specify the analyses to be performed by the analytical laboratory. The samples will be delivered to the laboratory within 24 hours of sampling, except as noted in Section 5.0 for samples collected on Friday. The samples will be accompanied by a Chain-of-Custody Record and will be delivered to the laboratory representative authorized to receive samples. Chain-of-custody records will be signed by the laboratory representative to verify delivery/receipt.

#### 4.3 SOIL SAMPLING

Soil sampling during borehole advancement will be performed for geologic/hydrogeologic and well design purposes only. All soil samples will be logged using the soil classification system shown on Figure A-4-1. A lithologic log of the soil and rock encountered in each boring will be maintained using a form similar to that shown on Form A-4-5. Details of well construction activities, including soil sampling, are provided in the Colbert Landfill Phase II Groundwater Monitoring Plan (Landau Associates 1992). Soil samples will not require specially cleaned laboratory-supplied sample bottles. Soil samples will be stored in a plastic tube or ziplock bag.

Sample labels are necessary to properly identify samples. Gummed paper labels or tags will be used for plastic tube samples, and ziplock bags will be labeled with an indelible marker. Sample containers will include the following information:

- Sample identification number
- Sampling date and time
- Sample location
- Name of sampler
- Depth of sample
- Pertinent field information.






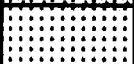









Sample containers will be labeled prior to or at the time of sampling.

Soil sampling equipment will be washed between borings to prevent cross-contamination borings by using the following procedure:

- Scrubbing with a brush using a solution of clean water and Alconox; this solution will be changed if it becomes muddy or obviously contaminated
- Rinsing with clean water; this will be performed by pouring clean water over the equipment until all soapy residue is removed
- Rinsing with distilled water by pouring distilled water over the equipment.

Soil samples will be stored at the Project office for review. Following completion of Phase II construction activities (or at a later date, if appropriate), the samples will be disposed of at the Site.

# Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL <sup>(1)</sup>	TYPICAL DESCRIPTIONS <sup>(2)(3)</sup>
COARSE-GRAINED SOIL (More than 50% of material is larger than No.200 sieve size)	GRAVEL AND GRAVELLY SOIL  (More than 50% of coarse fraction retained on No.4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL  (More than 50% of coarse fraction passed through No.4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No.200 sieve size)	SILT AND CLAY  (Liquid Limit less than 50)		ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity	
			CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay	
			OL	Organic silt; organic, silty clay of low plasticity	
	SILT AND CLAY  (Liquid Limit greater than 50)		MH	Inorganic silt; micaceous or diatomaceous fine sand or silty soil	
			CH	Inorganic clay of high plasticity; fat clay	
			OH	Organic clay of medium to high plasticity; organic silt	
HIGHLY ORGANIC SOIL				PT	Peat; humus; swamp soil with high organic content

- Notes: 1. USCS letter symbols correspond to the Unified Soil Classification System. Dual letter symbols (e.g., SM-SP) for a sand or gravel indicate a soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications. Only the first letter symbol's respective pattern is shown on logs.
2. Soil descriptions shown on logs are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488.
3. Soil description terminology (which is based on visual estimates of the percentages of each soil type) is as follows:  
 Primary Soil Type(s) - e.g., "GRAVEL," "SAND," "SILT," "CLAY," etc.  
 Secondary Soil Type(s) (>15%) - e.g., "gravelly," "sandy," "clayey," etc.  
 Modifier(s) (>5% and ≤15%) - e.g., "with gravel," "with sand," "with clay," etc.  
 Minor Component(s) (≤5%) - e.g., either "trace gravel," "trace sand," "trace clay," etc., or no mention of minor soil type



Project \_\_\_\_\_

Project No. \_\_\_\_\_

Collector \_\_\_\_\_

# Sample Collection Form

## PURGE DATA

Well Condition: Secure (☐ Yes / ☐ No); Describe Damage \_\_\_\_\_

Depth to Water (from top of well casing) \_\_\_\_\_

Begin Purge (mo/dy/yr) \_\_\_\_\_

End Purge (mo/dy/yr) \_\_\_\_\_

One Casing Volume (gal) \_\_\_\_\_

Gallons Purged \_\_\_\_\_

Well Casing Type/Diameter \_\_\_\_\_

(remove 3 well volumes or until pH/conductivity stabilize)

Volume of Schedule 40 PVC Pipe				
Diameter	O.D.	I.D.	Volume Gal/Linear Ft.	Weight of Water Lbs/Linear Ft.
1 1/4"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.20
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Vol. Purged	pH	Conductivity	Temperature	Comments/Observations
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Purge Water Disposal to \_\_\_\_\_

## SAMPLING DATA

Sample No. \_\_\_\_\_ Date Collected (mo/dy/yr) \_\_\_\_\_

Sample Location & Depth \_\_\_\_\_ Time Collected \_\_\_\_\_ AM PM

Sample Type (Soil, Ground Water, Other) \_\_\_\_\_ Weather \_\_\_\_\_

Sample Collected with ☐ Bailer ☐ Pump ☐ Split Barrel ☐ Other \_\_\_\_\_

Made of ☐ Stainless Steel ☐ PVC ☐ Teflon ☐ Other \_\_\_\_\_

Sampler Decon Procedure \_\_\_\_\_

Sample Description (Color, Texture, Density, Moisture, Turbidity, Etc.) \_\_\_\_\_

## FIELD PARAMETERS

Replicate	pH	Conductivity (μS)	Temperature (°F / °C)
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

Meters Used for Measurement: pH \_\_\_\_\_ Conductivity \_\_\_\_\_

Conductivity: Range \_\_\_\_\_, ATC ☐ On ☐ Off

pH 7: Reads \_\_\_\_\_ @ \_\_\_\_\_ °C

## ADDITIONAL INFORMATION

Sample Compositing Over Time, Distance \_\_\_\_\_

Quantity, Types of Sample Containers \_\_\_\_\_

Duplicate Sample Number(s) \_\_\_\_\_

Comments: (Why Analyze, Calculations, Etc.) \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_ Check if additional information on back ☐

350

**LANDAU ASSOCIATES, INC.**  
Edmonds, WA (206) 778-0907  
FAX (206) 778-6409

## Chain-of-Custody Record

Date \_\_\_\_\_

Page \_\_\_\_\_ of \_\_\_\_\_

[illegible]

3/80

**WHITE COPY - Project File**

**YELLOW COPY - Laboratory**

**PINK COPY - Client Representative**

**A-4-13**

LANDAU ASSOCIATES, INC.

Form A-4-2



# CUSTODY SEAL

LANDAU ASSOCIATES, INC.

P.O. BOX 1029 / EDMONDS, WA 98020-9129

PHONE: (206)778-0907 / FAX: (206)778-6409

Signature \_\_\_\_\_ Date \_\_\_\_\_

A-4-14

LANDAU ASSOCIATES, INC.

Form A-4-3

## Sample Analysis Request Packing List

<b>SAMPLER:</b> _____  Sampling Contact: _____ (name) _____ (phone number)	Sampling Date(s): _____  Date Shipped: _____  Site Name/Code: _____	Ship To:     Attn:	For Lab Use Only   Date Samples Rec'd _____  Rec'd By: _____
---	--	-----------------------------------	---


Sample Numbers	Sample Description i.e., Requested Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____
16. _____	_____	_____
17. _____	_____	_____
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____

For Lab Use Only

# Log of Exploration

Exploration No. \_\_\_\_\_  
Sheet \_\_\_\_\_ of \_\_\_\_\_

Client/Owner \_\_\_\_\_ Project No. \_\_\_\_\_  
Start Date \_\_\_\_\_ Hour \_\_\_\_\_  
Ground Surface Conditions \_\_\_\_\_  
Weather Conditions \_\_\_\_\_  
Landau Rep. \_\_\_\_\_ Contractor/Operator \_\_\_\_\_  
Exploration Method \_\_\_\_\_  
Hammer Weight & Stroke \_\_\_\_\_

Location Sketch (show dimensions to mapped features)   
Surface Elevation \_\_\_\_\_ Datum \_\_\_\_\_

Sample No./ Sampler Type	P.I.D. Reading	Penetration Resistance/5 in.	Length Driven	Sample Length Recovered	Sample Depth (ft.)	Graphic Recovery	Depth Scale (ft.)	USCS Symbol	Water Level Information				Soil Description	Comments
									Date	Time	Depth to Water	Hole Depth		
							0							
							1							
							2							
							3							
							4							
							5							
							6							
							7							
							8							
							9							
							0							
							1							
							2							
							3							
							4							
							5							
							6							
							7							
							8							
							9							
							0							
							1							
							2							
							3							
							4							
							5							
							6							
							7							
							8							
							9							
							0							

3/90  
Sampler: SPT, 2.4-in. ID Drive (2.4 D), Thinwall (TW), Shelby  
Tube (S), Bulk (B), etc. (Add "C" to sampler type if a catcher is used)

Finish Date \_\_\_\_\_ Hour \_\_\_\_\_ Continued ☐

TABLE A-4.1

## SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Matrix	Analyses	Sample Container <sup>(a)</sup>	Preservation	Holding <sup>(b)</sup> Time
Groundwater	Volatile Organics	2 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Cool, 4°C	14 days
Soil	Volatile Organics			
Influent/Effluent	Volatile Organics	4 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Cool, 4°C	14 days
NPDES	Total Dissolved Solids	16 oz plastic	None	7 days
	Hardness	4 oz plastic	H <sub>2</sub> SO <sub>4</sub> to pH <2	6 months
	Alkalinity	4 oz plastic	None	14 days
	Biological Oxygen Demand	16 oz plastic (no headspace)	None	48 hours
	Chemical Oxygen Demand	16 oz glass	Cool, 4°C H <sub>2</sub> SO <sub>4</sub> to pH <2	28 days
	Total Suspended Solids	15 oz plastic	None	7 days
	Total Organic Carbon	100 mL glass, Teflon-lined septum cap (leave no headspace)	Cool, 4°C H <sub>2</sub> SO <sub>4</sub> to pH <2	28 days
	Phosphorous (as P)	4 oz/8 oz plastic	None	48 hours

(a) Sample container specifications may be modified after consultation with the analytical laboratory.

(b) Holding times are from date of collection. All samples will be shipped to the laboratory within 24 hours (except as noted for samples collected on Friday).

A-4-17

## 5.0 SAMPLE HANDLING

Sample container description, preservation method, and the maximum holding time for analysis are presented for each sample type in Table A-4-1.

Samples will be shipped to the laboratory Monday through Thursday. Samples will not be shipped on Friday. Samples collected on Friday will typically be stored in a refrigerated area over the weekend, and shipped to the laboratory on Monday. Sample handling procedures will depend upon the required method of preservation.

Each sample that is preserved with acid (COD, TOC, and hardness) will be placed in a separate plastic bag. As much air as possible will be squeezed from the bags before sealing. Samples preserved with acid will either be transported directly to the laboratory by automobile, or will be shipped on an overnight carrier.

Samples that are not preserved with acid (volatile organics, BOD, TSS, TDS, alkalinity, and phosphorus) do not need to be placed in separate bags prior to shipment to the laboratory.

For all samples, an ice chest will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut from the inside and outside. Approximately 1 inch of packing material, such as asbestos-free vermiculite, will be placed in the bottom of the ice chest. The sample bottles will be placed in the ice chest. All ice chests will contain ice or frozen gel packs. The ice chest will be filled with packing material. Sufficient packing material will be used to prevent sample containers from making contact during shipment. The paperwork going to the laboratory will be placed inside a plastic bag and placed above the vermiculite packing. The ice chest will be taped shut with strapping tape. At least two Chain-of-Custody Seals (Figure A-4-3) will be placed on the outside of the ice chest (one in front and one on the back).

## **Field Instrumentation Use/Calibration Procedures**

## PHOTOIONIZATION METER

### Calibration Procedure<sup>(1)</sup>

Model: Photovac Microtip Air Monitor/Photoionization Detector (Microtip)

The Microtip must be calibrated in order to display concentration in units equivalent to ppm. First, a supply of Zero Gas, which contains no ionization gases or vapors, is used to set the Microtip's zero point; normally clean outdoor air can be used. Then, Span Gas containing a known concentration of an ionizable gas or vapor is used to set the response factor; normally 100 ppm isobutylene is used. To calibrate the instrument use the calibration kit with part no. 390033, as follows:

1. Connect the supplied regulator to the Span Gas cylinder and hand-tighten fittings.
2. Connect gas bag to Span Gas cylinder and flush the bag a few times with Span Gas and then fill it. Close gas bag by turning valve on bag clockwise.
3. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER (i.e., 1 to 5); press EXIT to leave Setup.
4. Press CAL and expose Microtip to Zero Gas, then press ENTER and Microtip sets its zero point.
5. The Microtip display then asks for Span Gas concentration. Enter the known Span Gas concentration (e.g., 100.00, for 100 ppm isobutylene) and then connect the Span Gas bag adaptor to the instrument inlet.
6. Press ENTER and the Microtip sets its response factor.
7. When Microtip's display reverts to normal the instrument is calibrated and ready to use.

The Microtip has 5 Cal Memories and can be calibrated with 5 different span gases if desired, but only one Cal Memory can be used at a time. Each memory stores a different zero point and response factor. Step 3 above is used to select which register (i.e., 1,105) will store the calibration setting.

The Microtip meter has a rechargeable battery that, when fully charged (requires 8 hours), should last for over 4 hours of continual use. When the "loBat" is displayed the instrument has approximately 10 minutes left of use before the battery runs out. The Microtip should be

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(1) Source: Microtip Hand Held Air Monitor/Photoionization Detector User's Manual by Photovac.

recharged after each day of field use; there is no danger of over-charging the Microtip battery with the Microtip recharger.

The Microtip should be calibrated every day of field use and results recorded in a project field notebook (e.g., time, date, calibration readings and user name).



## **HYDROGEN SULFIDE, OXYGEN, AND COMBUSTIBLE GAS INDICATOR**

### **Calibration Procedure**

**Model: MSA Hydrogen Sulfide, Combustible Gas and Oxygen Alarm  
Model 361**

Test the operation of the pump and sample flow indicator by momentarily placing a finger over the sample inlet of the instrument. The flow indicator should be at the top of the window before falling from view while the inlet is blocked. If not, see the instrument Instruction Manual for required maintenance.

- (1) Attach the flow control valve to the 0.75 percent pentane and 15 percent oxygen calibration gas tank.
- (2) Connect the adapter-hose to the flow control valve.
- (3) Open the flow control valve.
- (4) Connect the adapter-hose fitting to the inlet of the instrument; after approximately 15 seconds, the LEL meter should stabilize and indicate between 47 and 55 percent. If the indication is not in the correct range, remove the right end of the indicator and adjust the internal LEL SPAN control to obtain 50 percent.
- (5) Verify the oxygen reading; it should be between 13 and 17 percent. (This is a response check only, no internal adjustments are necessary. The oxygen sensor should be calibrated to 20.8 percent oxygen in fresh air before each use. This is accomplished by adjusting the oxygen span control on the front panel.)
- (6) Disconnect the adapter-hose fitting from the instrument.
- (7) Close the flow control valve.
- (8) Remove the flow control valve from the calibration gas tank.
- (9) Attach the flow control valve to the hydrogen sulfide calibration gas tank.
- (10) Open the flow control valve.
- (11) Connect the adapter-hose fitting to the inlet of the instrument; after approximately one minute, the TOX readout should stabilize and indicate 7 to 13 ppm. If the indication is not in the correct range, remove the right end of the indicator and adjust the internal TOX SPAN control to obtain 10 ppm.
- (12) Disconnect the adapter-hose fitting from the instrument.
- (13) Close the flow control valve.
- (14) Remove the adapter-hose from the flow control valve.
- (15) Remove the flow control valve from the calibration gas tank.

## **pH METER**

The pH of the groundwater and treatment system samples will be measured using the manufacturer's instructions for calibration and use. A two-buffer calibration with Automatic Temperature Compensation (ATC) will be used at a minimum of every four hours during sampling. The manufacturer's instructions follow.

## MEASUREMENT PROCEDURES

### pH Measurements

For maximum accuracy:

Perform a two buffer calibration once at the beginning of each day. This procedure provides the correct setting for the °C/slope control. Subsequent measurements can be made after a single buffer calibration.

Use ATC probe to automatically compensate for changes in slope due to variations in sample temperature.

#### Two Buffer Calibration (With ATC)

1. Plug ATC probe into input jacks and adjust °C/slope control knob to 25°C. Slide mode switch to temperature. Verify that ambient temperature is displayed.
2. Place electrodes in pH 7 buffer and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrodes from the buffer solution, rinse, and place electrodes in second buffer. Stir moderately. Allow reading to stabilize.
5. Adjust °C/slope control until correct value of second buffer is displayed. Remove electrodes from solution, rinse and place electrodes in sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

#### Two Buffer Calibration (Without ATC)

1. Sample and buffer temperature must be equal. Set °C/slope control to buffer temperature (°C).
2. Place electrode in pH 7 buffer and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrode from the buffer solution, rinse, and place electrode in second buffer. Stir moderately. Allow reading to stabilize.
5. Adjust °C/slope control until correct value of second buffer is displayed. Remove electrode from solution, rinse and place electrode in sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

If sample temperature differs significantly from the buffer temperatures used to calibrate, an adjustment can be made. Raise or lower the °C/slope control from its current setting, described in step 5, by the difference between the actual buffer temperature and the sample temperature. For maximum accuracy use ATC probe.

#### Single Buffer Calibration (With ATC)

The ATC probe replaces the manual temp/slope control on front panel with automatic compensation based on sensed sample temperature.

1. Plug ATC probe into input jacks and adjust °C/slope control knob to 25°C. Slide mode switch to temperature. Verify that ambient temperature is displayed.
2. If incorrect, adjust °C/slope control knob until actual temperature is displayed.
3. Place electrodes in a buffer solution with pH value within 1.5 units of the expected sample value and stir moderately.
4. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that pH value of buffer is displayed.
5. Remove electrodes from the buffer solution, rinse, and place electrodes into sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

#### Single Buffer Calibration (Without ATC)

1. Sample and buffer temperature must be equal. Set °C/slope control to buffer temperature (°C).
2. Place electrode in a buffer solution with pH value within 1.5 units of the expected sample value and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrodes from the buffer solution, rinse, and place electrodes into sample. Stir moderately. Allow reading to stabilize.
5. Record pH value displayed.

## CONDUCTIVITY METER

The conductivity of the groundwater and treatment system samples will be measured using the manufacturer's instructions. The manufacturer's instructions follow.

# CONDUCTIVITY STANDARDS

Approximate Normality	Weight of KCl in grams/1000 grams of Solution	Conductions in Micromhos @ 25°C
1.	71.1352	111,342
.1	7.41913	12,856.0
.01	.745263	1,408.77

## MAKING CONDUCTIVITY & TDS MEASUREMENTS with The Model 604

- I Cell Constant determination
  - Power "ON" (Lo Batt not on)
  - Cell connected
  - Function to A. T. C. "ON"
  - Range to "2000" $\mu\Omega$

Using three samples of the 718  $\mu\Omega$  standard solution (shipped with the Model 604), held at 25°C, dip the cell in the first solution. Allow the cell to temperature equilibrate to the standard solution. Withdraw cell and dispose of excess solution. Do not touch or wipe off the cell. Repeat this process in the second solution. Place the cell in the third solution for measurement. Measurement is to be made once cell is in the third solution. This reading will be most accurate if the measurement is made as soon as the cell is dipped in the third solution. Readings may change in some cases due to gases or other impurities absorbed from the atmosphere. Using the calibration tool set the standardize control to display .718. By changing the Function Switch to the standardize position, the constant maybe read directly from the display. (Example: 9.96; 10.00; 10.04). The Instrument is now ready to make percise conductivity measurements. In making measurements of unknown solutions, select '200,000'on Range Switch, ATC "ON" with Function Switch. Using three samples of the 'unknown solution', rinse the cell in the first sample solution.

Allow the cell to temperature equilibrate in the solution. Withdraw cell and dispose of excess solution. Do not touch or wipe off cell. Repeat this process in the second sample solution. Place the cell in the third solution for measurement. Measurement is to be made as soon as cell is in the solution. Having selected the appropriate range for reading, record same.

## CALIBRATION & MAINTENANCE

### Preventative Maintenance

1. The Model 604 requires no periodic maintenance.
2. Cleaning of the Model 604 should be done with a mild soap solution and a damp cloth.

### CAUTION

DO NOT ALLOW FLUIDS TO RUN INTO THE INSTRUMENT.

### ZERO CALIBRATION

Checking for proper Zero of Instrument.

Select ATC "ON"

Power "ON"

Cell connected (Dry & Clean)

Select these two ranges - 2 & 200,000 micromhos. In both positions the Digital Display should read 0 plus or minus a count. If not a Zero Calibration should be performed.

Remove four attaching screws on back of cover. Remove back cover. Consult the Component Layout Diagram (Reverse Side) in this publication for the location of R49 & R69. Diagram is found on page 12. R49 & R69 maybe accessed from reverse side of board. Holes are provided in PC Board for this purpose.

Instrument Power "ON"

Function Switch ATC "ON"

Range Switch "200,000"

Cell connected (Dry & Clean)

Adjust R49 for zero reading. Position Range Switch to "2". Adjust R69 for a Zero reading. This completes Zero Calibration. Reassemble the Instrument.

### USER INFORMATION

1. Care must be taken to avoid solution 'carry over'. The cell should be rinsed in a sample of the solution to be measured before the actual measurement is made.
2. Equilibrating the Cell - Agitate the cell in the solution to expediate temperature equilibration, and also assists in the dislodging of air bubbles.
3. Immersion of Cell - Cell is to be immersed in the solution a minimum of 1½ inches for proper measurement.
4. Therminister Time Constant - The Cell's Therminister time constant is approximately eighteen seconds.
5. Sample Measurements - Minimum amount of solution required for measurement - 1 ml in 10 mm test tube (ID).

## THERMOMETER

Model: Taylor Pocket Thermometer #21430-1  
(Range = 30° to 50° C)

### 1. Thermometer Calibration Procedure

- a. Each thermometer is labeled with an identifying number. The thermometer calibration will be documented in a dedicated calibration log book. All instrument calibrations and repairs will be recorded in the calibration log. The log book will describe the thermometer (make, model, purchase date, serial number, probe type, etc.).
- b. All thermometers will be calibrated against an NBS traceable thermometer. This thermometer will not be used in the field but will be retained in the Landau laboratory as a calibrated standard.
- c. Thermometers will be calibrated immediately after purchase and every six months thereafter, or if any unusual readings are obtained.

### 2. Temperature Measurement Procedure

- a. Immediately prior to calibration, the operator will enter his name, the date, and time of calibration in the log book. The instrument will be calibrated indoors.
- b. A two-point calibration will be conducted as follows: first, both the thermometer being calibrated (i.e., the field thermometer) and the NBS-traceable thermometer will be immersed in a container of ice and water. After waiting for the reading to stabilize, the operator will record both readings and calculate the error on the field thermometer. The procedure will be repeated with the water at room temperature (approximately 20-25°C). The field thermometer will be considered to be calibrated if it reads within 1°C of the NBS-traceable thermometer (i.e.,  $\pm 1^\circ\text{C}$ ). The information will be recorded as follows:

Initials	Date ddmmyy	Time	Temp NBS	Temp Field	Error (Field-NBS)
JML	3/3/88	1324	0.5	1	+0.5
JML	3/3/88	1324	18	19	+1.0



APPENDIX C

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**Field and Laboratory  
Audit Checklists**



## FIELD AND LABORATORY AUDIT CHECKLISTS

The field and laboratory checklists presented in this Appendix are duplicates of audit checklists used by the EPA's National Enforcement Investigations Center (NEIC 1984) in Denver, Colorado. These checklists have been selected for use on this project because they represent approved EPA audit checklists and reflect a standard of audit review appropriate to the project scope.

Selected audit observations in both the field and laboratory checklist may not be applicable to this project. When completing the audit checklists, the auditors will indicate nonapplicable observations by checking the corresponding "N/A" entry on this checklist.

**FIELD CHECKLIST**  
**Field Observations**

Yes\_\_ No\_\_ N/A\_\_

1. Was permission granted to enter and inspect the facility? (Required if RCRA inspection)

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Yes\_\_ No\_\_ N/A\_\_

2. Is permission to enter the facility documented? If yes, where is it documented?

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Yes\_\_ No\_\_ N/A\_\_

3. Were split samples offered to the facility? If yes, was the offer accepted or declined?

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Yes\_\_ No\_\_ N/A\_\_

4. Is the offering of split samples recorded? If yes, where is it recorded?

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Yes\_\_ No\_\_ N/A\_\_

5. If the offer to split samples was accepted, were the split samples collected? If yes, how were they identified?

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Yes\_\_ No\_\_ N/A\_\_

6. Are the number, frequency and types of field measurements and observations taken as specified in the project plan or as directed by the project coordinator? If yes, where are they recorded?

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Yes\_\_ No\_\_ N/A\_\_

7. Are samples collected in the types of containers specified for each type of analysis? If no, what kind of sample containers were used?

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Yes\_\_ No\_\_ N/A\_\_

8. Are samples preserved as required? If no or N/A, explain.

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Yes\_\_ No\_\_ N/A\_\_

9. Are the number, frequency and types of samples collected as specified in the project plan or as directed by the project coordinator? If no, explain why not?

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Yes\_\_ No\_\_ N/A\_\_

10. Are samples packed for preservation when required (i.e., packed in ice, etc.)? If no or N/A, explain why.

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Yes\_\_ No\_\_ N/A\_\_

11. Is sample custody maintained at all times? How?

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FIELD CHECKLIST  
Document Control

- Yes\_\_ No\_\_ N/A\_\_ 1. Have all unused and voided accountable documents been returned to the coordinator by the team members?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 2. Were any accountable documents lost or destroyed? If yes, have document numbers of all lost or destroyed accountable documents been recorded and where are they recorded?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 3. Are all samples identified with sample tags? If no, how are samples identified?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 4. Are all sample tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)? If yes, describe types of information recorded.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 5. Are all samples collected listed on a chain-of-custody record? If yes, describe the type of chain-of-custody record used and what information is recorded.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 6. If used, are the sample tag numbers recorded on the chain-of-custody documents?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Yes\_\_ No\_\_ N/A\_\_ 7. Does information on sample tags and Chain-of-Custody Records match?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 8. Does the Chain-of-Custody Record indicate the method of sample shipment?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 9. Is the Chain-of-Custody Record included with the samples in the shipping container?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 10. If used, do the sample traffic reports agree with the sample tags?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 11. If required, has a receipt for samples been provided to the facility (required by RCRA)? Describe where offer of a receipt is documented.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 12. If used, are blank samples identified?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 13. If collected, are duplicate samples identified on sample tags and Chain-of-Custody Records?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 14. If used, are spiked samples identified?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Yes\_\_ No\_\_ N/A\_\_ 15. Are logbooks signed by the individual who checked out the logbook from the project coordinator?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 16. Are logbooks dated upon receipt from the project coordinator?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 17. Are logbooks project-specific (by logbook or by page)?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 18. Are logbook entries dated and identified by author?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 19. Is the facility's approval or disapproval to take photographs noted in a logbook?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 20. Are photographs documented in logbooks (e.g., time, date, description of subject, photographer, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 21. If film from a self-developing camera is used, are photos matched with logbook documentation?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 22. Are sample tag numbers recorded? If yes, describe where they are recorded.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Yes\_\_ No\_\_ N/A\_\_ 23. Are calibration of pH meters, conductivity meters, etc., documented? If yes, describe where this is documented.

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Yes\_\_ No\_\_ N/A\_\_ 24. Are amendments to the project plan documented? If yes, describe where the amendments are documented.

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## FIELD CHECKLIST

### Debriefing with Project Coordinator

Yes\_\_ No\_\_ N/A\_\_ 1. Was a debriefing held with project coordinator and/or other participants?

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Yes\_\_ No\_\_ N/A\_\_ 2. Were any recommendations made to the project participants during the debriefing? If yes, list recommendations.

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**LABORATORY CHECKLIST**  
**Debriefing with Laboratory Personnel**

1. List observations made by the auditor.

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2. Make recommendations with respect to each observation.

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3. Discuss observations and recommendations made by the auditor.

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## LABORATORY CHECKLIST

SIGNATURE OF AUDITOR \_\_\_\_\_ DATE OF AUDIT \_\_\_\_\_  
LABORATORY \_\_\_\_\_ CEAT PROJECT NO. \_\_\_\_\_  
LABORATORY LOCATION \_\_\_\_\_  
CONTRACTS IN EFFECT \_\_\_\_\_

(List Contract Numbers)

1. Name of Sample Custodian and other personnel responsible for sample receipt and document control.  
\_\_\_\_\_  
\_\_\_\_\_
2. Where are the Sample Custodian's procedures and responsibilities documented?  
\_\_\_\_\_  
\_\_\_\_\_
3. Where are written Standard Operating Procedures (SOPs) pertaining to receipt of samples documented (laboratory manual, written instructions, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_
4. Where is the receipt of Chain-of-Custody Record(s) with samples being documented?  
\_\_\_\_\_  
\_\_\_\_\_
5. Review sample receipt documentation to assure that the nonreceipt of chain-of-custody record(s) with samples is being documented.  
\_\_\_\_\_  
\_\_\_\_\_
6. Where is the integrity of the shipping container(s) being documented (custody seal(s) intact, container locked or sealed properly, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_

7. Review the sample receipt documentation to assure that the lack of integrity of the shipping container(s) is being documented (i.e., evidence of tampering, custody seals broken or damaged, locks unlocked or missing, etc.)?
- 
- 
8. Determine, by asking the Sample Custodian or reviewing the laboratory SOP manual, if agreement among Sample Management Office forms, chain-of-custody records, and sample tags is being verified? State source of information.
- 
- 
9. Where is the agreement or nonagreement verification being documented?
- 
- 
10. Review sample receipt documentation to assure that sample tag numbers are recorded by the Sample Custodian?
- 
- 
11. Where are written Standard Operating Procedures (SOPs) pertaining to sample storage documented (laboratory manual, written instructions, etc.)?
- 
- 
- 12a. Do written SOPs and actual laboratory practices demonstrate laboratory security?
- 
- 
- 12b. Describe sample storage area (upright refrigerator in GC lab, walk-in cooler in sample receiving area, etc.).
- 
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13. How is sample identification maintained?
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14. How is sample extract (or inorganics concentrate) identification maintained?
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- 
15. How are samples that require preservation stored to maintain their preservation?
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16. How are written Standard Operating Procedures (SOPs) pertaining to sample handling and tracking documented?
- 
- 
17. What laboratory records are used to record personnel receiving and transferring samples in the laboratory?
- 
- 
18. Affirm that each instrument used for sample analysis (GC, GC/MS, AA, etc.) has an instrument log? List those instruments which do not.
- 
- 
19. Determine where analytical methods are documented and ask if methods are available to the analysts?
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- 
20. Determine where quality assurance procedures are documented and ask if procedures are available to the analysts?
- 
- 
21. How are written Standard Operating Procedures (SOPs) for compiling and maintaining sample document files documented?
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22. How are sample documents filed (by case number, internal laboratory number, batch number, sample number, etc.)?

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23. Review sample document files to determine if a document file inventory is prepared for each case file.

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24. Review sample document files to determine if all documents in the case files are consecutively numbered according to the file inventories.

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25. Observe the document file storage area to determine if the laboratory document files are stored in a secure area.

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26. Has the laboratory received any confidential documents?

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Complete questions 27, 28 and 29 ONLY if the response to question 26 was yes.

27. Review the case files to assure that confidential documents are segregated from other laboratory documents.

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28. Review the case files to assure that confidential documents are stored in a secure manner.

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30. Review recommendations from the previous audit to determine if the recommendations have been implemented. If not, the recommendations should be repeated and the laboratory director and the Project Officer should be notified.